CITY OF TITUSVILLE, FLORIDA

Technical Specifications
and
Contractor's Safety Requirements

prepared by

Water Resources Department - Utility Engineering Division

Armstrong WSF Modifications

CITY OF TITUSVILLE

ARMSTRONG WSF MODIFICATIONS

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

SECTION	TITLE
01001	General Requirements
01010	Special Project Procedures
02441	Directional Drill
02777	Concrete on Grade
09900	Painting
11210	Pumps - General
11211	High Service Pumps (Split Case)
11346	Chemical Feed Equipment
13421	Venturi Flow Meter
13442	Total Chlorine Residual/pH Analyzer (for information purposes, equipment is to be provided by City, installed by Contractor)
15108	High Density Polyethylene Pipe
15117	Water Regulating Valves
16050	Electrical-General Provisions
16110	Raceways and Fittings
16120	Wires and Cables
16130	Boxes
16140	Wiring Devices
16150	Motors
16160	Panelboards
16170	Pulse Variable Speed Drives
16900	Process Instrumentation and Controls – General Provisions
16915	Process Instrumentation and Controls – Products
16915-1	I/O Schedule (table)

CITY OF TITUSVILLE

ARMSTRONG WSF MODIFICATIONS

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

APPENDIX	TITLE
A	FDEP Permit (Armstrong WSF modifications and WM)
B	Brevard County Right of Way Permit (for WM)
C	Crom CECS Scope of Work
D	Technical Specifications for the Installation of Domestic Water Supply Mains

SECTION 01001

GENERAL REQUIREMENTS

1.01 WORK UNDER THIS CONTRACT

a. As indicated within these General Requirements and the following technical specification sections, all notices or other papers required to be delivered by the Contractor to the City/Engineer shall be delivered to the office of the Water Resources Engineer, CITY OF TITUSVILLE WATER RESOURCES DEPARTMENT, 2836 Garden Street, Titusville Florida 32796.

b. Work Hours: The Contractor shall perform work between 7:00 AM and 4:00 PM, Monday through Friday. No work shall be scheduled on major holidays. No work shall be performed on Saturdays or Sundays. Work shall not be performed at night without approval of the City or Engineer. The Contractor shall coordinate with the City any work period that is not as described above. The Contractor shall provide justification when requesting non-conforming work periods. The Contractor shall pay the City's overtime cost for the City's inspector for these periods.

1.02 INDUSTRY STANDARDS

Reference to the following standards of any technical society, organization or body shall be construed to mean the latest standard, code or specification or tentative specification adopted and published at the date of advertisement for bids, even though reference has been made to an earlier standard. Such reference is hereby made a part of the Contract the same as if herein repeated in full and in the event of any conflict between any of these specifications, standard codes or tentative specifications and the Contract Documents, the most stringent shall govern.

AA	Aluminum Association
AASHTO or AASHO	American Association of State Highway and Transportation Officials
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturer's Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	American Moving and Conditioning Association
ANSI	American National Standards
AWPA	American Wood Preservers Association
AWBP	American Wood Preservers Board
AWS	American Welding Society
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DOT Spec.	Standard Specification for Road and Bridge Construction Florida Department of Transportation
FS	Federal Standard
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NEC	National Electrical Code
NECA	National Electrical Contractor's Association
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NPT	National Pipe Threads

	Institute
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	American Standards Association (now ANSI)
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSBC	American Standard Safety Code for Building Construction
ASTM	American Society of Testing and Materials
NSF	National Science Foundation
OSHA	U.S. Department of Labor, Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	United States Products Standards
SAE	Society of Automotive Engineers
SDI	Steel Decks Institute
SJI	Steel Joists Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Structural Steel Painting Council
UL	Underwriter's Laboratories, Inc.
UASI or USAS	United States of America Standards Institute (now ANSI)

1.03 PROTECTION AND RESTORATION

1. The Contractor shall be responsible for the preservation of all public and private property, and shall use every means of protection necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor, at Contractors's expense, to a condition similar or equal to that existing before the damage was done. The protection and restoration shall be made in manner acceptable to the Engineer as follows.

2. Protection of Trees and Shrubs

    a. Protect with boxes, stakes and ribbon or other barricades.
    b. Do not place excavated material so as to injure trees or shrubs
    c. Install pipelines in short tunnels between and under root systems
    d. Support trees to prevent root disturbance during nearby excavation.

3. Tree and Limb Removal

    a. The City may direct the Contractor to remove trees along the line of trench excavation where noted on the drawings. City requested tree removal shall be paid for under the bid items for pipeline installation, if not provided for as a separate item in the Bid Schedule.

4. Trees or shrubs removed or destroyed by activity of the Contractor shall be replaced with new stock of similar type and size at the sole expense of the Contractor.

5. Lawn Areas - All lawn areas disturbed by construction shall be replaced with like kind to a condition similar or equal to that existing before construction. Where sod is to be removed, it shall be carefully removed, and the same resodded, or the area where sod has been removed shall be restored with new sod in the manner described in the applicable section.

6. Fences - Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor, and shall be left in as good a condition as before the starting of the work.

7. Where fencing, walls, shrubbery, grass strips or area must be removed or destroyed incident to the construction operation, the Contractor shall, after completion of the work, replace or restore to the original condition all such destroyed or damaged landscaping and improvements.

8. The cost of all labor, materials, equipment, and work for restoration shall be deemed included in the appropriate contract Item or items, or if no specific item is provided therefore, as part of the overhead cost of the work, and no additional payment will be made therefore.

1.04 MATERIALS AND EQUIPMENT

A. MANUFACTURER

1. All communication from the City/Engineer with the manufacturers, suppliers or sub-contractors shall be through the Contractor. If the Contractor allows, the City/Engineer or P&C Administrator may communicate with the Contractor, manufacturers and suppliers together in conference if needed. Nonetheless, the Contractor shall retain full responsibility for the contract.

2. All workmanship and materials shall be of the highest quality. The equipment shall be the product of manufacturers who are experienced and skilled in the field with an established record of research and development. No equipment will be considered unless the manufacturer has designed and manufactured equipment of comparable type and size for at least five years.

3. All materials and equipment furnished by the Contractor shall be subject to the inspection and approval of the Engineer. No material shall be delivered to the work without prior approval of the Engineer.

4. All apparatus, mechanisms, equipment, machinery, and manufactured articles for incorporation into the Project shall be the new and unused standard products of recognized reputable manufacturers.

5. Manufactured and fabricated products:

   a. Design, fabricate and assemble in accord with the best engineering and shop practices.

   c. Products shall be suitable for service conditions as specified and as stated by the manufacturer.

   d. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

6. Product Standards: Equipment and appurtenances shall be designed in conformity noted industry standards. They shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions or operations. All bearings and moving parts shall be adequately protected

against wear by bushings or other approved means. Provisions shall be made for adequate lubrication with readily accessible devices.

7. Equipment Clearances

   a. All equipment shall fit the allotted space and shall leave reasonable access room for inspection, servicing, and repairs. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.

8. Safety Requirements

   a. All machinery and equipment shall be safe-guarded in accordance with the safety codes of the ANSI, OSHA, and local industrial codes. Such guards or shields shall not interfere with lubrication of equipment.

   b. The Contractor or equipment supplier shall provide safety guards for belt drives or rotating equipment which shall be securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys or other moving or rotating equipment components.

   c. In addition to the components specified and shown on the Drawings and necessary for the specified performance, the Contractor shall incorporate in the design and show on the shop drawings all the safety features required by the current codes and regulations, including but not limited to those of the Occupational Safety and Health Act, and Amendments thereto.

9. Vibration

   a. All rotating mechanical equipment of 100 HP/76 KW or greater, unless otherwise specified or shown on the Drawings, shall be mounted on vibration isolators to isolate the equipment from the structure.

   b. Isolators shall produce uniform loading and deflections, regardless of equipment weight distribution, and shall be the product of a manufacturer regularly engaged in the production of such items and who publishes engineering and selection data.

   c. Vibration of rotating equipment shall not exceed the recommended limits of the respective manufacturing standards (i.e., pump vibration; National Hydraulic Institute Standards). Vibrations that exceed manufacturers, industrial standards or those specified shall be reduced to acceptable levels at no additional cost to the City.

10. Noise

    a. Unless otherwise specified or noted on drawings, all provided equipment shall not produce noise levels greater than 85 dBA when measured 3 feet from the equipment itself.

    b. Equipment which exceeds these noise level limitations shall be noted with the shop drawing submittal by the Supplier or Contractor. The

City/Engineer shall approve the equipment or request alternative equipment or noise reducing modifications to the equipment.

B. SUBSTITUTIONS

1. The substitution requirements of this Section are in addition to the requirements of the General Conditions and Supplementary Conditions.

2. When a product is specifically named by manufacturer or model or both, it is intended that the Bidder includes the cost for the named product in the bid form. Should the Bidder desire to substitute or provide alternate products to those specified, the Bidder shall request approval of said product by submitting detailed information as described in the General Requirements to the Purchasing & Contracting Administrator for review. The substitute product or products submitted by the Bidder shall meet the requirements of the specifications in all respects or they shall vary only in some way that is beneficial to the City. The request for substitution will result in an addendum to the bidding documents or it shall be rejected without notice. The City shall not accept a substitution request within the ten (10) days prior to the bid opening.

3. The intent of these specifications is to provide the City with a quality facility without discouraging use of products that are equal to those specified.

   a. For products specified only by reference standards, performance and descriptive methods, without naming manufacturer's products, the Contractor may provide the product of a manufacturer that complies with said requirements, subject to the review of product data, performance, etc., by the City/Engineer as specified herein.

   b. For products specified by naming one or several manufacturer's, the Contractor may provide any of the named products subject to the shop drawing review of product data by the City/Engineer as specified herein.

   c. For products when “or equal”, is indicated, the Contractor may provide said “or equal” product by submitting detailed shop drawing information to the City/Engineer for approval. Products not accepted by the City/Engineer shall not be used in the project or contract.

C. DELIVERY AND STORAGE

1. General

   a. The Contractor shall be responsible for all material, equipment and supplies sold and delivered to the City under this Contract until final inspection of the Work and acceptance thereof by the City.

   b. All materials and equipment shall be handled and stored by the Contractor following delivery in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage or any kind whatsoever to the material or equipment.

c. All materials which, in the opinion of the Engineer, have been damaged during shipment or delivery as to be unfit for the use intended or specified shall be promptly removed from the site of the Work, and the Contractor shall receive no compensation for the damaged material or its removal.

2. Storage

a. The Contractor shall be responsible for securing a storage location for all material and equipment. Material and equipment shall be stored in compliance with manufacturer's requirements or recommendations.

b. All materials and equipment or products delivered to the job site shall be protected from dirt, dust, dampness, water, exposure and any other condition detrimental to the life of the material from the date of delivery to the time of installation of the material and acceptance by the City/Engineer.

c. The Contractor shall furnish a covered, weather protected storage structure providing a clean, dry, noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment to be used this project.

d. Mechanical equipment to be used in the Work, if stored for longer than ninety (90) days, shall have the bearings cleaned, flushed and lubricated prior to testing and start-up, at no extra cost to the City.

e. The Contractor shall not store any materials on the Citys site that are not specifically purchased for the subject construction work. Only materials that are per the approved shop drawings and fully compliant with project requirements shall be stored at the site.

3. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice to do so has been given, the City retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering and any other costs associated with making the necessary corrections. In any event, equipment and materials not properly stored will not be included in a payment estimate.

D. MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

1. The Contractor shall comply with manufacturer's printed instructions and include such instructions with shop drawing submittals. Maintain one set of complete instructions at the job site during installation and until completion.

2. If requirements stated herein conflict with the manufacturer's instructions for same, the Contractor shall indicate such to the City/Engineer.

3. The Contractor shall have on hand sufficient construction equipment and machinery to facilitate the installation of the products or equipment items.

4. Equipment shall be installed on the foundations at the locations and elevations shown on the plans, unless directed otherwise by the Engineer during installation.

5. All equipment shall be correctly aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.

6. The Contractor shall furnish and install anchor bolts as recommended by the equipment manufacturer and as approved by the Engineer. Equipment manufacturer's recommended anchor bolts or attachment requirements shall be submitted with shop drawings.

E. OPERATING AND MAINTENANCE MANUALS

1. The Contractor shall furnish two (2) sets of preliminary manufacturers' operation and maintenance materials and manuals for review by the City/Engineer in the same manner as shop drawing submittals. The Contractor shall furnish five (5) sets of final equipment manufacturer's operation and maintenance materials and manuals for use by the City, after incorporating Engineer's review comments. Final O&M manuals shall be complete before substantial completion and equipment start-up.

2. Each manufacturer shall provide a recommended maintenance schedule guide for each item of equipment. Each manual shall include lubrication instructions for the equipment; the lubrication instruction shall include a list of recommended lubricants, with cross references, for each recommended type of lubricant. The manuals are intended to be used as a guide for routine maintenance and should include tasks necessary for properly maintaining the equipment.

F. MANUFACTURER'S SERVICE

1. Where service by the manufacturer is specified to be provided, the Contractor shall include the cost in the bid item for the equipment, or if none is provided, in other project cost as indicated.

2. The services provided shall be by a qualified manufacturer's service representative to check the completed installation, place the equipment in operation, and instruct the City's operators in the operation and maintenance procedures. Such services are to be for a period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the job and does not include travel time.

3. The manufacturer's services shall further demonstrate to the Engineer's complete satisfaction that the equipment will satisfactorily perform the functions for which is has been installed.

G. INSPECTION AND TESTING

1. If any material or equipment fails during testing or fails to meet requirements and thus does not comply with the Contract, the Contractor shall be notified thereof, and shall remove non-compliant material or equipment promptly from the site, to be replaced without cost to the City.

2. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with specific sections herein.

3. Testing Cost

   a. The Contractor shall employ and pay for the services of a qualified independent testing laboratory to perform required testing or sampling and analysis as specified herein or as required by the City's referenced utility construction standards.

   b. The cost of field leakage and pressure tests and shop tests of materials and equipment specifically called for in the Contract Documents shall be borne by the Contractor, and such costs shall be deemed to be included in the unit cost of those items. Example: cost for testing pipe shall be included in cost per foot of pipe installed.

   c. The City/Engineer may request "additional" other than required testing by the Contractor. Additional testing that is passing or meets performance requirements shall be paid for by the City. Additional testing that fails to meet requirements shall be paid for by the Contractor. Such costs shall be deducted from any payments due to the Contractor.

   d. The Contractor shall pay for all Work required to uncover, remove, replace, test, etc any Work that was not tested as required due to the Contractor's omission or lack of compliance with testing requirements.

4. Shop Testing

   a. Specified equipment for which any pressure, duty, capacity, rating, efficiency, or other performance criteria are specified, shall be tested and certified by the manufacturer to meet the requirements of the Contract Documents. Certified test results shall be submitted to the City/Engineer and approved before the equipment is installed.

   b. When indicated in the contract documents, the City reserves the right to observe manufacturing or testing of products or equipment as specified. The Contractor shall assist, inform and notify the City of the location and time of manufacturing and testing.

   c. The Contractor must comply with these provisions before installing any material. Such inspections by the City shall not release the Contractor from the responsibility for providing equipment or materials meeting the requirements of the Contract Documents.

5. Field Testing

   a. The City shall employ and pay for services of an independent testing laboratory to perform testing specifically indicated in the Contract Documents. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract.

   b. The City may at any time during the progress of the Work request additional testing beyond that which is specified in the Contract. This

testing will be at the City's expense. The Contractor shall assist the testing laboratory personnel in all ways so as to facilitate access to the location of the material or equipment to be tested.

c. Contractor shall:

1) Cooperate with laboratory personnel, provide access to the Project.

2) Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

3) Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes which require control by the testing laboratory.

d. The following schedule summarizes the responsibilities of various tests that may be required by the Contract Documents. Contractor shall notify City in advance of work so that arrangements can be made with the testing laboratory.

6. Demonstration Tests: Upon completion of the Work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance or demonstration tests as specified or required to provide compliance with the Contract Documents.

7. Final Inspection: Prior to preparation of the final payment application, a final inspection will be performed by the City and the Engineer to determine if the Work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

H. WARRANTIES AND BONDS

1. The Contractor shall submit warranties and bonds as specified in the General Conditions and as specified herein. Warranties shall be included in Operation and Maintenance submittals.

2. For all major pieces of equipment, the Contractor shall submit a warranty from the equipment manufacturer. "Major" equipment is defined as a device having a 1.0 HP or larger motor or which lists for more than $1,000.00. The manufacturer's warranty period shall be concurrent with the Contractor's for one (1) year, unless otherwise specified, commencing at the time of final acceptance by the City. The Contractor shall warrant all equipment in the Contractor's one year warranty period even though certificates of warranty may not be required.

3. In the event that the equipment manufacturer or supplier is unwilling to provide a one-year warranty commencing at the time of the City acceptance, the Contractor shall obtain from the manufacturer a two (2) year warranty commencing at the time of equipment delivery to the job site. This two-year warranty from the manufacturer shall not relieve the Contractor of the one-year warranty starting at the time of City acceptance of the equipment.

4. If an individual specification section requires a particular warranty more stringent than that required by this Section or the General Conditions, the more stringent requirements shall govern for the applicable portion of the Work.

5. The warranties and bonds shall include the following as applicable:

    1. Equipment or product description. Manufacturer's name, principal, address and telephone number.
    2. Contractor, name of responsible principal, address and telephone number.
    3. Local supplier's or representatives name and address.
    4. Scope of warranty or bond Proper procedure in case of failure.
    5. Instances which might affect the validity of warranty or bond.
    6. Date of beginning and duration of warranty, bond or service maintenance contract.

I. TOOLS, NAMEPLATE AND SPARE PARTS

1. Special Tools: The Contractor shall furnish with each type, kind or size of equipment, one complete set of suitably marked high grade special tools which may be needed to maintain, repair and lubricate the equipment.

2. Nameplate: Each piece of equipment shall be provided with a stainless steel nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, model, serial number, weight and principal rating data including RPM and horsepower.

3. Spare Parts: The Contractor shall provide spare parts for equipment as required in the individual specification sections. Spare parts shall be provided in the manufacturers packaging and delivered to the City at the time of acceptance.

J. GREASE, OIL AND FUEL

1. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. The City shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.

2. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than four weeks of continuous operation.

K. HAULING AND CONSTRUCTION OPERATIONS:

1. The Contractor shall conduct access, hauling, filling and storage operations on-site as specified herein and as shown on the Contract Drawings. Payment for material quantities shall be included in overhead or unit cost unless specific items are provided in the bid form.

2. Borrow Material: All borrow material required shall be obtained on-site if available. Fill material if needed shall be obtained off-site at the Contractors cost.

3. Excess Suitable Material: Under no circumstances shall surplus suitable material be disposed of in wetland areas as defined by the FDEP or USACOE. On-site spoil areas for excess suitable materials are designated on the Drawings.

4. Unsuitable Material: All unsuitable material shall become the property and responsibility of the Contractor. The Contractor shall properly dispose of all such unsuitable materials off-site in accordance with local, State and Federal Regulations.

L. USE OF CHEMICALS: All chemicals used by the Contractor including herbicide, pesticide, disinfectant, polymer, reactant or other classification, must show approval of either the Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions. The Contractor shall notify the City/Engineer if any chemicals to be used, are capable of contamination of the water supply.

M. QUALITY ASSURANCE: In order to establish a standard of quality and to demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes and surfaces, the Contractor shall provide such samples of workmanship or finish as may be required by the City. The materials and equipment used on the Work shall correspond to the samples or other data approved as a quality standard for the Work.

1.05 PROJECT SITE AND ACCESS

A. RIGHT-OF-WAY AND EASEMENTS

1. The use of public streets and alleys shall be such as to provide a minimum of inconvenience to the public and to other traffic. Any earth or other excavated material spilled from trucks shall be removed by the Contractor and the streets cleaned to the satisfaction of the City.

2. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the property owner.

B. EXISTING FACILITIES: The Work shall not require an interruption of existing facilities in operation. Special procedures are required for any work that will require interruption of a utility service or operation of an existing facility. Requirements and schedules of operations for maintaining existing facilities in service during construction are described in special project procedures, section 01010..

C. ACCESS

1. Neither the material excavated nor the materials or equipment used in the construction of the Work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.

2. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business access with the business City. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored and all construction debris removed within 48 hours of backfilling trench.

3. Contractor agrees that representatives of the City and any governmental agents will have access to the Work wherever it is in preparation or progress and that the Contractor shall provide facilities for such access and inspection.

1.06 PERMITS

A. The City may have obtained permits related to this work prior to advertising. Permits previously obtained shall be included with the bidding documents.

B. Upon Notice of Award, the Contractor shall immediately apply for all other applicable permits to construct the Work from the appropriate governmental agency or agencies. No Work shall commence until all applicable permits have been obtained and copies delivered to the City/Engineer. The costs for obtaining these permits shall be borne by the Contractor.

C. The Contractor shall strictly adhere to the specific requirements of the regulatory agencies having jurisdiction over the Work. Conditions of permits or requirements noted in permits shall be effective and included in the Contracted work.

1.07 UTILITIES

A. UTILITY CONSTRUCTION

1. Utility installations and structures shall include all poles, tracks, pipes, wires, conduits, private service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto, whether owned privately, commercially or by the public (City). All public or private property which may be affected by the Work shall be deemed included hereunder.

2. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required.

3. The length of open trench will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the City. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the City may require special construction procedures. As a minimum, the Contractor shall conform to the following restoration procedures:

a. Interim Restoration: All excavations shall be backfilled and compacted as specified by the end of each working day. For excavations within existing paved areas, limerock base shall be spread and compacted to provide a relatively smooth surface free of loose aggregate material. All driveway cuts shall be backfilled and compacted. Road base shall be spread and compacted immediately after utility installation. Any utility crossing an existing roadway, parking lot or other paved area shall be patched by the end of the working day. Private driveways shall be temporarily restored until final restoration can be made.

b. Final Restoration: After completing all utility installations, and after testing of the pipe, final restoration shall be performed. Final

Restoration shall be completed before Subtantial Completion. Any additional restoration required after utility testing shall be performed in a timely manner at no additional cost to the City.

c. Restoration for Work in Business or Commercial Districts: The Contractor shall restore all private property, damaged by construction, to its original condition. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business accesses with the business owner. Such prearranged access agreements shall be indicated in writing and signed by the Owner. Property drainage and grading shall be restored within 24 hours of backfilling trench.

B. EXISTING UTILITIES

1. The locations of all existing underground piping, structures and utilities have been taken from information received from the respective owner. The locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered.

2. The Contractor shall, at all times in performance of the Work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of existing public utility installations and structures; and shall, at all times in the performance of the Work, avoid unnecessary interference with, or interruption of, public utility services; and shall cooperate fully with the owners thereof to that end.

3. Pipelines shall be located substantially as indicated on the Drawings, but the City/Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. When the location of piping is dimensioned on the Drawings, it shall be installed in that location; when the location of piping is shown on a scaled drawing, without dimensions, the piping shall be installed in the scaled location unless the City/Engineer approves an alternate location for the piping. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

4. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities which do not interfere with the completed Work shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his expense as directed by the City/Engineer. Any existing facilities which require operation to facilitate repairs shall be performed only by the owner of the respective utility.

5. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the proximity of excavation, be temporarily stayed and/or shored in position while Work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

C. NOTICES

1. The Contractor shall notify and schedule Sunshine State One Call to identify and locate existing utility pipelines and systems in the work area. Call 811 or contact by internet (www.callsunshine.com), Sunshine State One Call of Florida (SSOCOF).

2. The Contractor shall also comply with Florida Statute 553.851 regarding notification of existing gas and oil pipeline company owners. Evidence of such notice shall be furnished to the City within two weeks after the execution of the Contract.

3. It shall be the Contractor's responsibility to contact utility companies at least 48 hours in advance of breaking ground in any area or on any unit of the work so maintenance personnel can locate and protect facilities, if required by the utility company.

4. The Contractor shall, prior to interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the utility owner and make arrangements for the interruption which will be satisfactory to the utility owner.

D. EXPLORATORY EXCAVATIONS: Exploratory excavations shall be conducted by the Contractor for the purpose of locating existing underground pipelines or structures in advance of the construction work. Excavations or Soft Digs with vacuum equipment shall target areas of potential conflicts between existing and proposed piping a minimum of 48 hours or 1000 feet in advance of Work. The Contractor shall coordinate the work accordingly to avoid delays as needed.

E. UTILITY CROSSINGS: It is intended that wherever existing utilities must be crossed, deflection of the pipe within specified limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the City/Engineer this procedure is not feasible, he may direct the use of fittings for a utility crossing or conflict transition as detailed on the Drawings.

F. RELOCATIONS

1. Relocations shown on the Drawings - Public utility installations or structures, including but not limited to light poles, signs, fences, piping, conduits and drains that interfere with the positioning of the Work which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as part of the general cost of doing the Work and shall be included in the prices bid for the various contract items.

2. Relocations not shown on the Drawings

   a. Where public utility installations or structures are encountered during the course of the Work, and <u>are not</u> indicated on the Drawings or in the Specifications, and when, in the opinion of the City/Engineer, removal, relocation, replacement or rebuilding is necessary to complete the Work under this contract, such Work shall be accomplished by the utility having jurisdiction, or such Work may be ordered, in writing by the City/Engineer, for the Contractor to accomplish.

   b. If such Work is accomplished by the utility having jurisdiction, it will be carried out expeditiously and the Contractor shall give full cooperation

to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such Work is accomplished by the Contractor, it will be paid for as a Change Order.

3. All existing utility castings, including valve boxes, junction boxes, manholes, hand holes, pull boxes, inlets and similar structures in the areas of construction that are to remain in service and in areas of trench restoration and pavement replacement, shall be adjusted by the Contractor to bring them flush with the surface of the finished Work.

4. All existing utility systems which conflict with the construction of the Work herein which can be temporarily removed and replaced shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the Work may be done by the Contractor.

1.08 RELATED CONSTRUCTION REQUIREMENTS

A. TRAFFIC MAINTENANCE

1. Maintain public highway traffic within the limits of the project for the duration of the construction period, including any temporary suspensions of Work. Work shall also include construction and maintenance of any necessary detour facilities; furnishing, installing and maintaining of traffic control and safety devices during construction, control of dust, or any other special requirements for safe and expeditious movement of vehicular and pedestrian traffic.

2. Traffic Control shall be provided at the Contractor's expense by the Contractor's personnel or off-duty uniformed police officer, depending on and as required by the applicable traffic control requirements jurisdictional to the construction or road.

3. The Contractor shall prepare a Traffic Control Plan prior to commencing any Work on the site. The Traffic Control Plan shall detail procedures and protective measures for protection and control of traffic affected by the Work consistent with the following applicable standards:

   a. City of Titusville, Traffic Control Manual

   b. Manual on Uniform Traffic Control Devices, Maintenance and Utility Operations, FDOT, FHWA.

   c. Right-of-Way Utilization Regulations, Brevard County, Florida, Latest Edition.

4. Permits: Before closing any thoroughfare, the Contractor shall obtain a Street Closing Permit from the City of Titusville. Public notice shall be given no less than 72 hours in advance of the time when it may be necessary in the process of construction to close such thoroughfare, or as may be otherwise provided in the approved Traffic Control Plan.

5. The Contractor shall sequence and plan construction operations and shall generally conduct his Work in such a manner as not to unduly or

unnecessarily restrict or impede existing normal traffic through the streets of the local community.

6. Insofar as it is practicable, excavated material and spoil banks shall not be located in such a manner as to obstruct traffic. The traveled way of all streets, roads and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary.

7. If required by the City, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such a manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the City/Engineer and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or property resulting from his work.

8. The Contractor shall make provisions at all "open cut" street crossings to allow a minimum of one lane to be open for vehicular traffic at all times. Lane closing shall be as permitted by the local governing authority and shall be repaired to a smooth, safe driving surface immediately following the installation of pipe or conduit. Flagmen shall be required, in addition to barricades, signs and other protective devices at all lane closings.

9. The Contractor shall make provisions at cross streets for the free passage of vehicles and pedestrians, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters.

B. BARRIER AND LIGHTS: The Contractor shall exercise extreme care in the conduct of the Work to protect health and safety of the workmen and the public. The Contractor shall provide all protective measures and devices necessary, in conformance with applicable local, state and federal regulations regarding their need and use. Protective measures shall include but are not limited to barricades, warning lights/flashers and safety ropes.

C. DEWATERING, FLOTATION: The Contractor, with his own equipment, shall do all pumping necessary to dewater any part of the Work area during construction operations to insure dry working conditions. The Contractor shall be completely responsible for any tanks, wet wells or similar structures that may become buoyant during the construction and modification operations due to the ground water or floods and before the structure is put into operation. The proposed final structures have been designed against buoyancy; however, the Contractor may employ methods, means and techniques during the various stages of construction (or other conditions) which may affect the buoyancy of structures. Should there be any possibility of buoyancy of a structure, the Contractor shall take the necessary steps to prevent its buoyancy either by increasing the structure's weight, by filling it with approved material or other acceptable methods. Damage to any structures due to floating or flooding shall be repaired or the structures replaced at the Contractor's expense.

D. DUST, NOISE AND EROSION CONTROL

1. The Contractor shall prevent dust nuisance from his operations or from traffic by the use of water and deliquescent salts.

2. Noise Suppression

   a. The Contractor shall eliminate noise to as great an extent as practical at all times. Air compressing plants shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. In the vicinity of hospitals and schools, special care shall be used to avoid noise or other nuisances. The Contractor shall strictly observe all local regulations and ordinances covering noise control.

   b. Sound levels measured by the City/Engineer's personnel shall not exceed 45 dBA after 8 p.m. or 55 dBA 8 a.m. to 8 p.m. This sound level shall be measured at the exterior of the nearest exterior wall of the nearest residence or building. Levels at the equipment shall not exceed 85 dBA at any time. Sound levels in excess of these values are sufficient cause to have the Work halted until equipment can be quieted to these levels. Work stoppage by the City/Engineer for excessive noise shall not relieve the Contractor of other contractual responsibilities stipulated in the Contract Documents including, but not limited to Contract Price and time.

3. Erosion and Sedimentation Control

   a. Temporary erosion controls include, but are not limited to, grassing, mulching, netting, watering and reseeding on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the City, FDEP, ACOE, and the Water Management District.

   b. Temporary sedimentation controls include, but are not limited to, silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the City, FDEP and any other agency having jurisdiction.

   c. The construction of temporary erosion and sedimentation control facilities shall be in accordance with the FDOT Standard Specifications for Road and Bridge Construction.

   d. Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective.

E. CONSTRUCTION FIELD ENGINEERING

1. Professional Engineer: The Contractor shall provide the services of a Registered Professional Engineer currently licensed in the State of Florida for the following specific services as applicable to the Work:

a. Inspections, testing, witnessing requiring a licensed professional engineer;

b. Design of temporary shoring, sheeting, bridging, scaffolding or other temporary construction;

c. Other requirements as specified herein.

2. Registered Land Surveyor: The Contractor shall retain the services of a registered land surveyor licensed in the State of Florida for the following specific services as applicable to the Work:

a. Identify existing rights-of-ways points, property lines and permanent survey monuments along, within or adjacent to the Work;

b. Locate existing utilities, structures and other improvements to remain in service that may be affected by the Work.

c. Prepare a certified survey of the actually constructed facilities based on information concurrent with the construction progress. This site survey is herein referred to as "Project Record Drawings". The Project Record Drawings shall indicate the actual locations of all building corners, structures and elevation and stationing (min 100 ft. stationing) of all piping, fittings, valves, conduits, existing utilities and all other above and below ground improvements constructed under this contract.

3. Control: The Contractor shall protect control points prior to starting the Work and shall preserve all permanent reference points during construction. Report to the City/Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

The Contractor shall bear the cost of re-establishing project control points if disturbed, and bear the entire expense of rectifying Work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes and marks.

4. Submittal: the Contractor shall provide certified survey in electronic format, Autocad DWG format.

F. LINES AND GRADES

1. All Work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

2. The Contractor shall establish and maintain all working or construction lines and grades as required from the project control points set by the City/Engineer, and shall be solely responsible for the accuracy thereof.

3. The stationing shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed. All locations must be approved by the City/Engineers Inspector.

4. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:

   a. Gravity Lines: Continuous control, using laser technology.

   b. Pressure Lines: Control stakes set at 50 ft intervals using surveyors level instrument.

G. CUTTING AND PATCHING

1. The Contractor shall do all cutting, fitting or patching of his portion of the Work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the City and in accordance with the Drawings and Specifications.

2. Preparation

   a. Inspect the existing conditions of the project, including elements subject to damage and/or movement during cutting and patching.

   b. Provide adequate temporary support to assure the structural integrity of all facilities during completion of the Work.

3. Performance

   a. Execute cutting and demolition by methods which will prevent damage to other existing facilities and will provide proper surfaces to receive installation of equipment and repair.

   b. Excavation and backfilling shall be performed in a manner which will prevent settlement and/or damage to existing facilities.

   c. All pipes, sleeves, ducts, conduits and other penetration through surfaces shall be made airtight.

   d. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

H. TEMPORARY CONSTRUCTION

1. Temporary fences: If, during the course of the Work, it is necessary to remove or disturb any fencing, the Contractor shall, at his own expense, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The Engineer will be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.

2. Responsibility for Temporary Structures: In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and save harmless the City from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

I. TEMPORARY FACILITIES

1. Contractor shall furnish, install and maintain temporary facilities required for construction, and shall remove them upon completion of the Work. All facilities shall comply with the respective federal, state and local codes and regulations and with utility company requirements.

2. Materials for temporary facilities may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

3. Temporary Utilities

a. Temporary Electricity and Lighting: The Contractor shall make all arrangements for temporary power service to the site as needed to perform the work as specified. Lighting shall be provided as needed.

b. Temporary Heat and Ventilation

1) The Contractor shall provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate the progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity. Portable heaters shall be standard U.L. approved units complete with controls.

2) The Contractor shall provide adequate force ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.

c. Telephone service: The Contractor and Contractors Superintendant shall be available by telephone during working periods.

d. Temporary Water

1) The Contractor shall provide water for construction and testing purposes, shall install branch piping with taps located so that water is available throughout the construction by the use of hoses, and shall protect piping and fittings against freezing as applicable to the work site.

2) The Contractor may use the existing water supply systems for testing, flushing, and construction water only at the direction of the City/Engineer. The Contractor shall pay for all water used in performing the above functions in accordance with the City's established water rate schedules. The Contractor shall install at each and every connection to a public water supply a backflow preventer and all other appurtenances required by the City/Engineer, codes and regulations. Contractor shall be required to meter all water used.

e. Temporary Sanitary Facilities: The Contractor shall provide sanitary facilities in compliance with laws and regulations.

f. Payment for Utilities: The Contractor shall make all necessary applications and arrangements and pay all fees and charges for electrical energy for power and light, gas energy, water and sanitary service, and/or telephone service required for the construction and testing of the Work under this Contract during its entire progress.

J. CONSTRUCTION DOCUMENTATION

1. Preconstruction Documentation: The Contractor shall engage the services of a professional videographer to record pre-construction conditions no more than 45 days and no less than five days prior to construction. The videographer shall be a commercially known firm skilled and regularly engaged in the business of continuous preconstruction color audio-video documentation. The videographer shall not be an employee of the Contractor or in anyway associated with the Contractor. No construction shall begin prior to the review and approval of the respective audio-video by the City and Engineer. All audio-video and written records shall become the property of the City.

a. Video Recording

1) High quality digital format audio-video on DVD, Blu-Ray or other format approved by City/Engineer

2) Screen Display: time of day, month, day and year.

3) Coverage: record all existing surface features located within the area affected by construction featuring existing improvements and vegetation and existence of any faults, defects or fractures thereto.

4) Each disk shall be permanently labeled and provided with subject data (street name, direction, engineering station numbers and date).

5) Recording shall be performed in good weather with stable continuity of coverage at a rate not exceeding five miles per hour, with camera not mounted more than 10 feet above ground.

b. Audio Recording

1) Single voice narrative recording corresponding and simultaneous with the video recording.

2) Provide commentary to assist viewer orientation; street name, side, direction of travel, house addresses, engineering station numbers.

K. WEEKLY REPORTS

1. The Contractor shall submit to the City's Representative weekly reports of construction activities. The reports shall be complete in detail and shall include the following information:

a. Weather Information; delays, inactivity, etc.
b. Work activities with reference to the project schedule.
c. Major milestones, inspections, testing, MOT changes
d. Quantity of performed work in period, completed work items.
e. New problems, issues, downtime, deliveries, etc.
f. Sub-contract performed work quantity or progress.

2. For each week, the CONTRACTOR shall prepare a "Weekly Progress Report", document form approved by City. The report shall be submitted to the City's Inspector or Engineer. Each report shall be signed by the CONTRACTOR's Superintendent or Project Manager.

L. CLEANING

1. During Construction

a. During construction, the Contractor shall, at all times, keep the work area free from used materials, trash and debris.

b. The Contractor shall remove from the site all surplus materials and temporary structures when no longer necessary to the Work at the direction of the City/Engineer.

2. Final Cleaning

a. At the conclusion of the Work, all equipment, tools, temporary structures and materials belonging to the Contractor shall be removed. Thoroughly clean all installed equipment and materials. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

b. The Work shall be left in a condition as shown on the Drawings and the remainder of the site shall be restored to a condition equal or better than what existed before the Work.

c. Prior to final completion, or City occupancy, Contractor shall conduct an inspection of interior and exterior surfaces, and all work areas to verify that the entire Work is clean. The City/Engineer will determine if the final cleaning is acceptable.

M. PROJECT SIGNS: shall be required if shown and as detailed on the drawings.

1.09 CONSTRUCTION NOT PERMITTED

A. USE OF EXPLOSIVES: No blasting or use of explosives is allowed.

B. BURNING: Do not burn combustible materials. Remove all cleared material from the Work site and dispose of in accordance with all local laws, codes, and ordinances. Organic (trees, etc.) waste may be chipped if there is sufficient area to perform this work.

C. EXCAVATED SUITABLE MATERIAL SURPLUS: All suitable topsoil and excavated material shall remain stockpiled at the City/Engineer's direction.

1.10 PROJECT MEETINGS

A. GENERAL

1. The Engineer will schedule and administer the preconstruction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work. A summary of each progress meeting will be prepared before any subsequent meeting.

B. PRECONSTRUCTION MEETING

1. A preconstruction meeting shall be held following Notice of Award and before the date of Notice to Proceed at a time and location coordinated by the Purchasing and Contract Administrator.

2. Recommended Attendance

a. Inspector (Engineer's or City's)
b. Purchasing and Contract Administrator
c. Engineer and his professional consultants
d. Contractor and his superintendent
e. Major subcontractors
f. Major suppliers
g. Utilities
h. Others as appropriate

3. Suggested Agenda: This meeting is intended to introduce the various key personnel from each organization and to discuss the requirements of the Contract Documents as to how they specifically pertain to this Project and Work. The City may prepare a agenda for this meeting outlining specific construction administration procedures, general construction requirements and other special considerations.

C. PROGRESS MEETINGS

1. Progress meetings will be held monthly following the pre-construction meeting. The City and Contractor shall establish a day, time and location for the monthly meeting at the pre-construction meeting.

2. Representatives of the City, Contractor, subcontractors and other parties as needed shall attend the monthly meetings. The Contractors project superintendant is required for all meetings.

3. The Contractor shall study previous meeting minutes and current agenda items in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the Work, etc.

4. The Contractor is to provide a current shop drawing log at each progress meeting, as well as evidence of the completion of Project Record Drawings concurrent with Work progress.

1.11 CONSTRUCTION PROGRESS SCHEDULE

A. Within thirty (30) days after Award of the Contract or before the Preconstruction Meeting, prepare and submit to the City/Engineer estimated construction progress schedules for the Work with sub-schedules of related activities which are essential to its progress. The construction schedule shall as required by City of Titusville Purchasing and Contracting Department and the Purchasing and Contract Administrator.

1.12 SHOP DRAWINGS, WORKING DRAWINGS AND SAMPLES

A. GENERAL: The Contractor shall submit to the Engineer for review and approval, if any, such working drawings, shop drawings, test reports and data on materials and equipment, and material samples as are specified elsewhere in the specifications and in the Contract Drawings.

B. CONTRACTOR'S RESPONSIBILITY - The Contractor shall:

1. Check all drawings, data and samples prepared by or for him before submitting them to the Engineer for review;

2. Stamp each data submittal with "Contractor's Stamp" indicating materials or products comply with requirements. Shop drawings submitted to the Engineer without the "Contractor's Stamp" will be returned for non-conformance with this requirement;

3. Determine and verify field measurements, coordinate with material submittals, identify size of materials to be supplied, etc.

4. Determine and identify specific catalog numbers and similar data (other catalog or manufacturer's data not pertinent to the submittal shall be crossed or marked out).

5. The Contractor shall obtain approval for all materials before the materials are used in the Work. The Contractor shall remove and replace and bear all cost for any rejected material placed in the work.

6. Submit to the Engineer all shop drawings, samples and schedules sufficiently in advance of construction requirements to provide no less than thirty (30) calendar days for checking, and appropriate action;

7. List exceptions or non-conformance to the specifications taken by the Contractor in the letter of Shop Drawing Transmittal to the Engineer.

C. ENGINEER'S RESPONSIBILITY

1. The City/Engineer will review the Contractor’s shop drawing submittals in detail to verify conformance with the letter and intent of the contract documents. The Engineer's review and approval constitutes a limited, conditional or qualified authorization to use such materials or equipment and does not constitute an approval of dimensions, quantities, quality or methods of performing work or installation.

2. The City/Engineer will coordinate distribution, perform review, coordinate responses and return shop drawing submittals or reply with indicated action

or comments within twenty eight (28) calendar days of receipt from the Contractor. The returned submittals shall be stamped by the City/Engineer.

3. The City/Engineer may reject and return shop drawings to the Contractor without action or review with the following applicable notation:

   a. "Contractor's Stamp Required - Incomplete Review by Contractor", or
   b. "Submittal is Not Required by Contract Documents", or
   c. "Submittal is Incomplete-Requires Coordination with Other" or
   d. "Contract Variation Not Noted in Transmittal".

D. SUBMITTAL PROCEDURES

1. Preliminary Shop Drawing Data: At the Preconstruction Meeting, the Contractor shall submit to the Engineer a complete listing of manufacturers and a schedule for all items for which shop drawings are to be submitted.

2. Submittal Log: The Contractor shall maintain an updated log of submittals to be review by the City/Engineer at each scheduled progress meeting.

3. The City/Engineer shall return submittals to the Contractor with comments and review action indicated on the "Shop Drawing Review Comment Sheet" or on the submittal itself with comments marked in "red" pen.

4. If the Contractor submits materials to show a departure or variation from the Contract Requirements, there shall also be submitted a "statement of non-conformance", that indicates the reason for the variation including why the variation is needed or the benefit to the City for accepting the variation.

5. Re-submittals will be handled in the same manner as first submittals. The Contractor shall provide further information, verify required information and make any corrections required by the Engineer.

6. The Engineer will review re-submittals a maximum of two (2) times after which the Contractor shall reimburse the City for review cost for subsequent reviews.

7. Partial or un-coordinated submittals may be returned, not reviewed. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until properly resubmitted. Unless otherwise specifically permitted by the Engineer, all submittals shall be grouped containing all associated items for:

   a. Systems (ex: roofing system, deck, truss, shingles,etc.)
   b. Processes (ex: disinfection system, pumps, injectors, etc.)
   c. As indicated in specific specification sections.

8. The actual required number of submittal copies will be determined at the Pre-Construction meeting. The Engineer will distribute shop drawings.

9. All shop drawing submittals shall be accompanied with a transmittal letter providing the following information: 1) Project Title and Contract Number 2) Date 3) Contractor's name and address. 4) The number of each shop drawing, project data, and sample submitted. 5) Notification of non-

conformance to Contract Documents. 6) Submittal Log Number conforming to specification section numbers.

a) Submit each specification section separately.
b) Identify each shop drawing item required under respective specification section.
c) Identify re-submittals using specification section followed by A (first re-submittal), B (second re-submittal) etc.

E. SAMPLES: The Contractor shall furnish, for the approval of the Engineer, samples required by the Contract Documents. Approval of a sample shall not be construed to change or modify any Contract requirements. Materials and equipment incorporated in Work shall match the approved samples.

1.13 START-UP

A. GENERAL: As soon as conditions permit, the Contractor shall furnish all labor, fuel, energy, lubrication, water, and all other materials, equipment, tools, and instruments necessary for the following tests: Start-up, Check-Out, and Demonstration and Testing.

1. Coordinate start-up activities with the City's operating personnel at the project site and with the Engineer.

2. Demonstrate to the Engineer that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their own controls as designed.

B. Start-up Certification all pipelines and Potable and Raw Water Mains or System:

1. Flushing, Disinfection, Testing and Certification or Clearance

a. Completed piping shall be flushed clean (all pipes).

b. Potable and Raw water mains shall be disinfected and bacteriologically tested as required by the City of Titusville, Technical Specifications for the Installation of Domestic Water Supply Mains, Current Edition and as required for FDEP clearance.

C. Start-up CHECK-OUT Certification (Mechanical/Equipment/Pumps, etc.)

1. Conduct start-up testing with the Manufacturer's field service representative to test the equipment installation to the satisfaction of the Manufacturer.

2. Confirm that all equipment is properly energized, that the valves are set to their normal operating condition and that the flow path through the new work is unobstructed.

3. Slowly fill each hydrostatic structure in the process flow stream with water.

4. Observe the component operation and make adjustments as necessary to optimize the performance of the Work.

5. Coordinate with City for any adjustments desired or operational problems requiring debugging. Make adjustments as necessary.

6. Submit a CHECK-OUT MEMO signed by the Contractor and the manufacturer's representative to the City/Engineer.

D. Start-Up DEMONSTRATION AND TESTING Certification

1. After the start-up CHECK-OUT is completed in accordance with the manufacturer requirements, and perform Start-up DEMONSTRATION AND TESTING in the presence of the Engineer and the City.

2. The intent of the start-up demonstration and testing is for the Contractor to demonstrate to the City and Engineer that the Work will function as a complete and operable system under normal as well as emergency operating conditions and is ready for acceptance.

3. Start-up DEMONSTRATION AND TESTING of pipelines will be conducted using water supplied by the City at locations approved by City. The Contractor shall supply and install properly operating backflow preventer(s) as specified under Subsection 1.13B of this Section on all connections to the City's potable water system.

E. FAILURE OF TESTS

1. Any defects in the materials and equipment or their failure to meet the tests, guarantees or requirements of the Contract Documents shall be promptly corrected by the Contractor by replacements, improvements, or otherwise at no cost to the City. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive.

2. If the Contractor fails to make these corrections or if the improved materials and equipment, when tested, shall again fail to meet the guarantees or specified requirements, the City, notwithstanding partial payment for work, and materials and equipment, may reject the nonconforming materials and equipment and may order the Contractor to remove them from the site at his own expense.

3. If the City rejects any materials and equipment, then the Contractor shall replace the rejected materials and equipment within a reasonable time. If the Contractor fails to do so, the City may, after the expiration of a period of thirty (30) calendar days after giving him notice in writing, proceed to replace such rejected materials and equipment. The cost thereof shall be deducted from any compensation due or which may become due the Contractor under his Contract.

F. CONTRACTOR'S CLOSE-OUT SUBMITTALS TO CITY/ENGINEER

1. Project As-Built Drawings and Records. Drawings shall be provided in electronic format, Autocad (dwg file) or as provided to the Contractor for this use.

2. Operating and Maintenance Data, warranties, spare parts.

END OF SECTION

SECTION 01010

SPECIAL PROJECT PROCEDURES

1.01 PURPOSE

A. Special project procedures are specific instructions and requirements that are intended to serve various purposes including; coordinating activities, establishing limits of the work, or identifying some specific work item or requirement that cannot readily be shown or described on the construction plans or technical specifications. The following Special Project Procedures are requirements and effective to the contract.

1.02 ARMSTRONG WSF – CURRENT STATUS

During the period of this project, the Armstrong WSF will not be in operation. The 3.5 million gallon concrete storage tank is not currently used. The pumping equipment is also not in service at this time. The active part of this facility, to remain in operation, includes pipes into the facility from the Cocoa interconnect point (24" transmission main) and the 24" water main to the Titusville water system, as well as the connection between these two water mains located in the southeast corner of the Pump Building. The active equipment includes a control valve and pressure transducer located in the southeast corner of the pump building. The remainder of the facility is off-line until the completion of this project.

1.03 PROJECT SITE SECURITY

A. The integrity of the Armstrong WSF is crucial for the supply of potable water. The site security and protection of this public water supply facility requires the following measures be taken during the construction phase due to additional required access and activity.

B. The Contractor shall be responsible to maintain an account of all personnel that work directly or indirectly (subcontractors) on this project and that shall have access to the site. All personnel shall be identified while working or present on the site by a badge or other identification method. The Owner shall provide a list of those who are currently authorized to access the site for operation,

C. The Contractor shall staff a security officer to maintain access control for the duration of the project and to identify all that access to and from the site and maintain the account of those with project/site access. The Contractors security officer shall be present at all times after the site gate is unlocked and until the site is closed and the site gate is locked again.

D. The Contractor's security officer shall keep a record of observation that includes the names of all workers that entered the site on a daily basis. Copies of the records of observation shall be provided to the City's Inspector on a weekly basis along with other weekly construction reports.

E. The Contractor shall restore and maintain all existing fencing that is disturbed or removed by construction activities for the duration of the project. Fencing that may be removed for construction purposes shall be restored by the end of the work day and before the security personnel leave the site for that day. Gates shall be locked at all

times when the contractor is not working on the site and when security staff are not present.

F. The Contractor shall prepare a security plan with specific security procedures to address any specific problems with maintaining site security. The security plan will be reviewed and approved by the Owner and shall be considered as an addendum to the requirements stated above. The security plan shall be reviewed at each progress meeting and revised as needed.

1.04 INSTALLATION OF DISTRIBUTION FLOW METER (FM-2)

A. The work that includes installation of the distribution flow meter will require a discontinuation of service and depressurization of the potable water distribution system. Specifically, the distribution piping adjacent to the meter location between the nearest isolation valves shall be depressurized to allow the installation of the flow meter and associated piping. The following requirements shall apply to this work.

B. The Contractor shall identify this work item in the project schedule following mobilization onto the site. The Contractor shall also provide up-date of the schedule and final notice at least 7 days before the start of the work is anticipated.

C. The Contractor shall obtain all products, piping, fittings and materials needed to install the flow meter before initiating the flow meter installation. All possible work that can be performed before initiating the installation shall be done to reduce the time necessary for the installation itself.

D. The installation of the flow meter (FM-2) beginning with the depressurization of the isolated segment of piping shall begin at the earliest possible time within a full days work shift.

E. The Contractor shall install the meter and complete all piping modifications and disinfect the isolated piping as required. Samples shall be provided for FDEP clearance. The Contractor shall follow all procedures for FDEP clearance and all conditions of the permit for this work.

F. The distribution piping with the installed flow meter will be opened to the system following clearance by FDEP and acceptance by the City.

1.05 SAFETY AND HEALTH REQUIREMENTS

A. General: In accordance with the requirements of the OSHA Regulations for Construction, the Contractor shall provide and require the use of personal protective and lifesaving equipment for all persons working in or about the project.

B. Head and Face Protection and Respiratory Devices: Applicable health and safety precautions required by appropriate regulatory agencies such as OSHA, ANSI, etc., should be followed.

C. Ventilation: Ventilation shall be adequate to reduce the contamination of air contaminant to the degree that a hazard to the worker does not exist.

D. Sound Levels: Whenever the occupational noise exposure exceeds the maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination: Adequate illumination shall be provided while work is in progress. Whenever required by the RPR, the Contractor shall provide additional illumination sufficient to cover all areas to be checked. The level of illumination required for observation purposes shall be determined by the RPR.

F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to the applicable requirements of the OSHA Regulations for Construction. They shall be erected where requested by the RPR to facilitate proper construction observation and be moved by the Contractor to locations requested by the RPR.

1.06 REMOVAL AND SALVAGE OF EXISTING HIGH SERVICE PUMPS

A. The Contractor shall remove (3) existing high service pumps as shown on the drawings, sheet 3. The Contractor shall remove the pumps from the concrete base that is to remain and to be used for the new pumps. The Contractor shall repair any damage to the existing pump base.

B. The pumps may be lifted and moved to the south end of the building with the existing overhead travelling bridge hoist system. The roll-up door allows access by equipment for loading the pumps onto Contractors trailer or truck for removal. The Contractor may remove the pumps whole or in parts, I.E., pump, motor, and frame. The weight of these items is as follows: pump volute, 1030 lbs., 200 HP electrical motor, 1,720 lbs., frame base, approx. 200 lbs., total weight: 2,950 lbs.

C. The pumps and other items noted that are to be salvaged shall be transported by the Contractor to the City's salvage yard on Buffalo Road, adjacent to the Osprey WRF. The Contractor shall unload the pumps and other salvage items at this site as directed by the City. The Contractor shall have no further responsibility for the unloaded materials.

1.07 16-INCH TANK INLET CONNECTION

A The existing 3.5 million gallon prestressed concrete cylindrical tank located at the Armstrong WSF site was constructed in 1995-96 by the Crom Corpration of Gainesville, Florida. Crom Engineering and Construction Services Incorporated (CECS) is a division of the Crom Corporation that is engaged in the business of making modifications to existing tanks similar to the piping connection in this project.

B. The Contractor shall obtain a price from CECS (subcontractor) to perform the work as shown on the plans and as described in the attachment "Connection Scope", included with these documents as an appendix (C). The purpose of including this document is to identify the scope or limits of work for this sub-contract.

1.08 CLEANING AND DISINFECTION OF STORAGE TANK

A. The Contractor shall clean the interior of the existing 3.5 MG storage tank following the work of installing the new inlet connection piping and supports. The interior of the tank

shall be washed and all contents removed. All contents removed shall be captured and disposed off-site by the Contractor.

B. The Contractor shall disinfect all interior surface areas of the tank, following the washing and prior to placing of the tank into service. Disinfection of the water storage tank shall comply with AWWA standard C652-11, “Disinfection of Water-Storage Facilities. All applicable requirements of the standard C652-11 shall be effective to this contract. Tank water samples shall be taken and tested as per the verification requirements. If samples taken indicate bacteria present, the disinfection process shall be repeated. The tank shall be placed into operation following all verification of testing results and acceptance by the City/Engineer.

End of Section

SECTION 02441

DIRECTIONAL DRILLING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work under this Section consists of furnishing all labor, equipment and materials necessary for the installation and testing of a High Density Polyethylene (HDPE) water main, force main or reclaimed water main by horizontal directional drilling as shown on the Drawings and specified herein.

1.02 STANDARDS

A. HDPE pipe and fittings shall conform to Section 15108, AWWA C901, C906 and these Specifications.

1.03 SUBMITTALS

A. The Contractor shall submit Shop Drawings, Working Drawings and samples in accordance with the General Requirements. In addition, the requirements of each related section and the following shall apply.

B. Shop Drawings for piping and appurtenances shall be prepared by the manufacturer and include, as a minimum, the following:

1. Details of all fittings and other appurtenances.

2. Provide detailed drawings of joints to be supplied.

3. Calculations and/or test data demonstrating that the proposed joint arrangement can transmit the required forces.

4. Copy of the manufacturer's quality control check of materials and production. Provide mill test certificates or certified test reports on pipe and fittings.

5. Provide from the manufacturer an affidavit of compliance with AWWA standards referenced in the Specifications. Affidavit shall be included with Shop Drawings submittals.

C. Provide a layout schedule and line drawings including:

1. Order of installation and closures.

2. Pipe invert station and elevation at changes of grade and alignment.

3. Elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.

4. Locations of closures for length adjustment and for construction convenience.

5. Contractor shall field verify dimensions, elevations, potential alignment obstructions and construction criteria prior to preparing the tabulated layout schedule and line drawings.

6. Details of the transition coupling and restraining methods.

D. The directional drilling Contractor (or Subcontractor) shall be a Certified Underground Utility Contractor listed with the Florida Department of Business and Professional Regulation.

E. List of materials and equipment for directional drilling, including dimension ratio of HDPE pipe based on required pull back strength.

F. Proposed pressure testing location for HDPE or PVC pipe before directional boring.

1.04 QUALITY ASSURANCE

A. Standards: All pipe, fittings and other appurtenances shall conform to the latest AWWA standards.

B. Qualifications: Directional drilling contractor (or subcontractor) shall have a minimum of five years experience with similar construction including pipelines of the same or larger diameter and the same or greater lengths.

C. All materials shall be subjected to visual inspection following delivery and prior to installation. Materials that do not conform to the Specifications will be rejected and must be removed immediately from the job site by the Contractor.

1.05 DELIVERY, STORAGE AND HANDLING

A. Pipe materials damaged during transport or delivery shall be rejected and removed from the site. On site pipe storage shall meet AWWA standards and the pipe manufacturer's storage requirements or recommendations.

D. The Contractor shall properly store and protect the pipe materials until the pipe is installed. Pipe damaged in any way during storage shall be removed from the project. There will be no payment for damaged materials.

E. The Contractor shall store fittings in their original cartons. All materials that are delivered in protective packaging shall remain packaged until needed for installation.

F. Material handling shall comply with the pipe manufacturer's requirements or recommendations.

PART 2 - PRODUCTS

2.01 GENERAL

A. Drilling mud shall be bentonite clay slurry or equal approved by the Engineer.

2.02 PIPE

A. HDPE pipe shall have a ductile iron pipe size (DIPS) as specified in Section 15108 and shown on the drawings. The dimension ratio shall be verified by the Contractor based on the pipe pull strength required for the directional drilling. Pipes shall be marked in accordance with AWWA requirements and as specified in Section 15108.

PART 3 - EXECUTION

3.01 GENERAL

A. Install two (2) 10 gauge copper wire with plastic coating for pipe tracing/detection. Tracer wire, if broken during pull back, shall be replaced with new wire.

B. HDPE ends shall be welded to a transition fitting for connection to ductile iron pipe fitting with mechanical restraint. Restrained length from transition connection shall be 34 feet minimum.

3.02 INSTALLATION

A. Erosion and sedimentation control measures and on-site containers shall be installed to prevent drilling mud from spilling out of entry and/or exit pits. Drilling mud will be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.

B. No other chemicals or polymer surfactant shall be added to the drilling mud without written consent of the Engineer. Allowed chemicals used shall be environmentally safe or biodegradable.

C. The pipe entry area shall be graded to provide support for the pipe to allow free movement into the bore hole. The pipe shall be guided in the bore hole to avoid deformation of, or damage to, the pipe.

D. As-built variance from the designed bore path shall not exceed □1 foot in the vertical plane and 2 feet in the horizontal plane. Contractor shall submit any proposed deviations from the design bore path with shop drawings. Pipe that does not meet the aforementioned tolerances shall be a considered defective. The Owner/Engineer may require such defective pipe to be replaced by the Contractor with non-defective pipe at no additional cost to the Owner.

3.03 DISINFECTION AND TESTING

A. Perform disinfection and pressure testing of HDPE pipe as per Utility Standards.

END OF SECTION

SECTION 02777

CONCRETE ON GRADE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: The work included in this Section consists of furnishing all labor, material, equipment and transportation for the construction of concrete on grade to the lines and grades as shown on the Drawings. Concrete on grade shall include equipment pads, piping pads, walkways and pad areas in sitework. Concrete on grade does not include foundations or building slabs.

1.02 SUBMITTALS

A. All materials specified shall be certified by the producer or manufacturer that the furnished material meets the specific requirements of the specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Welded Wire Fabric: Welded wire fabric shall be 6 x 6-W4/W4 welded wire fabric conforming to the requirements of Section 03200 unless shown otherwise on the drawings.

B. Concrete: All cast-in-place concrete work shall be performed in accordance with ACI 318 and ACI 350R except as hereinafter specified. Concrete shall be 4000 psi rated at 28 day strength. Concrete shall be of portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be ready-mixed, or transit-mixed concrete produced by a plant acceptable to the Engineers. All constituents, including admixture, shall be batched at the central batch plant in accordance with ASTM C94. Materials shall conform to these Specifications and any State or local specification requirements.

C. Preformed Joint Filler: Preformed joint filler shall be non-extruding and resilient bituminous type and shall conform to the requirements of ASTM Designation D 1751.

D. Membrane Curing Compound: Membrane curing compound shall be clear fugitive dye and conform to the requirements of AASHTO Designation M 148, Type 1-D.

PART 3 - EXECUTION

3.01 PREPARATION

A. Subgrade Condition

1. The finished subgrade shall be compacted in accordance with Section 02300 and shall be maintained in a smooth, compact condition and any areas which are disturbed prior to placing of the concrete shall be restored at the Contractor's expense. The subgrade shall be moist at the time the concrete is placed. Water shall be uniformly applied ahead of the pouring operations. Large boulders and other obstructions shall be removed to a minimum depth of 6 inches below the finished subgrade elevation, and the space shall be backfilled with sand. Base course material or other suitable material shall be thoroughly compacted by rolling or tamping.

2. The subgrade shall be accurately trimmed to the required elevation within a 1/4-inch tolerance. High areas shall be trimmed to proper elevation. Low areas may be filled with suitable material and compacted to the specified density or filled with concrete integrally with the placing of the pavement.

B. Setting Forms: The forms shall be accurately set to line and grade and such that they rest firmly, throughout their entire length upon the compacted subgrade surface. Forms shall be joined neatly and tightly and braced to resist the pressure of the concrete and the finished operations. The alignment and grade of all forms shall be approved before and immediately prior to the placing of concrete.

C. Slipforming: The slipforming method will be allowed, provided that an acceptable finished product, true to line, grade, and cross section is consistently produced.

3.02 INSTALLATION

A. Placing Concrete

1. The concrete shall be distributed on the subgrade to such depth that, when it is consolidated and finished, the thickness required by the Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface. The concrete shall be deposited on the subgrade in a manner which will require as little rehandling as possible. Placing of the concrete shall be continuous between transverse joints, without the use of intermediate bulkheads.

2. Concrete shall be thoroughly consolidated against and along the faces of all forms by means of vibrators. Vibrators shall not be permitted to come in contact with the subgrade or a side form. Vibration at any one location shall not continue so long as to produce puddling or the accumulation of excessive grout on the surface. In no case shall the vibrator be operated longer than 15 seconds in any one location.

B. Striking-off, Consolidating And Finishing Concrete: Immediately after the placing, the concrete shall be struck off, consolidated and finished, to produce a finished product conforming to the cross section, width and surface finish required by the Drawings and Specifications.

C. Straightedging And Surface Corrections

1. After floating has been completed and the excess water removed, but while the concrete is still in a plastic state, the surface of the concrete shall be tested for trueness with an accurate 10-foot straightedge. The straightedge shall be furnished by the Contractor. The straightedge shall be held in successive positions parallel to the walk center line, in contact with the surface, and the whole area tested from one side of the slab to the other as necessary. The advance along the walk shall be in successive stages of not more than one-half the length of the straightedge.
2. Any depressions shall be immediately filled with freshly mixed concrete and struck-off, consolidated and refinished. High areas shall be cut down and refinished.

3. Straightedge testing and surface correction shall continue until the entire surface conforms to the required grade and cross section. All surface irregularities exceeding 1/4-inch in a 10-foot section shall be corrected.

D. Final Finish: As soon as the water sheen has disappeared and just before the concrete becomes nonplastic, the top shall be given a light broom finish perpendicular to the forms. Finally, all edges, including expansion joint edges, shall be finished with an edging tool having a radius of 1/4-inch.

E. Joints

1. Transverse Construction Joints: Transverse construction joints shall be constructed at the end of all pours and at other locations where the pouring operation are stopped for as long as 30 minutes. Construction joints, however, shall not be placed within five feet of any other transverse joint or of either end of a section of walk. If sufficient concrete has not been placed to form a slab at least five feet long., the excess concrete, back to the last preceding joint, shall be removed. The joints shall be formed by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and center line of the walk. Construction joints shall have tooled edges with a 1/4-inch radius.

2. Transverse Contraction Joints: Transverse contraction joints shall be formed at five foot intervals and shall consist of planes of weakness created by an edging tool. The cut in the fresh concrete shall be perpendicular to the surface of the walk, shall extend to a depth of 1-1/2-inches below the top surface and shall have 1/4-inch radius tooled edges.

3. Transverse Expansion Joints: One half-inch expansion joints shall be formed by placing preformed joint filler around all structures and at intervals not exceeding 25 feet.

F. Curing

1. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not

occur, the entire surface and the edges of the newly placed concrete shall be covered and cured with membrane curing compound.

2. Curing compound shall be uniformly applied to the surfaces to be cured, in a single coat, continuous film, at the rate of one gallon to not more than 200 square feet, by a sprayer.

3. Curing compound shall not be applied during periods of rainfall. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms the sides of the slabs exposed shall immediately be coated to provide a curing treatment equal to that provided for the surface.

G. Form Removal: After the concrete has sufficiently set a minimum of 12 hours, the Contractor shall remove the forms and shall backfill the space on each side. The earth shall be compacted and graded in a satisfactory manner without damage to the concrete work. Honeycombs shall be filled with sand cement mortar. Plastering will not be allowed on the face of the walk. Rejected walk shall be removed and replaced without additional compensation.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The scope of work of this section consists of furnishing all materials, labor, equipment and incidentals required and performing all painting necessary to complete the Work in its entirety.

B. It is the intent of these Specifications to paint all proposed concrete, exposed miscellaneous metal, pipe, fittings, valves, equipment and all other work obviously required to be painted unless otherwise specified. It is also intended to paint all existing interior and exterior surfaces affected or damaged by this project which may be exposed to view in the finished work including, but not limited to, concrete, metals, pipe, fittings, valves, equipment and all other existing items similar to proposed items specified for painting. Table 09900-A outlines the painting system to be applied to specific areas. Items omitted in the Table shall be included in the scope of work of this Section where they come within the general intent of the specifications as stated herein.

C. In general the following surfaces are to be painted unless specified specifically not to be painted in Table 09900-A or 1.01 D below.

1. Exposed piping and other metal surfaces, interior and exterior.
2. All submerged metal surfaces.
3. All structural and miscellaneous steel, including tanks.
4. The interior of tanks and wet wells.
5. All exterior above-ground concrete.
6. The interior of structures.
7. Equipment furnished without factory furnished surfaces or damaged factory surfaces.
8. Doors, woodwork and architectural trim work.

D. The following surfaces or items are NOT required to be painted:

1. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in or in contact with concrete shall be coated to prevent electrolysis.

2. Aluminum gratings, checkered plates, hatches, handrails, toeboards, stairways and walkways.

3. Stainless steel, brass, bronze, and aluminum other than exposed tubing.

4. Aluminum, galvanized, or vinyl fencing.

5. Piping buried in the ground or embedded in concrete.

6. Ducts, pipes and other miscellaneous items covered with insulation or plastic coated.

7. Concealed concrete or masonry.

8. Seamless flooring.

9. Concrete walkways.

10. Furring.

11. Finish hardware.

12. Manhole frames and covers.

13. Nonferrous architectural metals, unless specifically noted otherwise.

14. Fiberglass.

15. Packing glands and other adjustable parts and nameplates of mechanical equipment.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. It is the intent of this specification that all paints specified in this section be supplied by one coatings supplier and be the product of one manufacturer, unless a specialty coating not available from that manufacturer is specified.

2. The paint manufacturer shall have supplied paint for water and wastewater facilities for a minimum of five (5) years, and products supplied shall be contained within the manufacturer's standard water and wastewater brochure.

3. Acceptable manufacturers are listed in Part 2 of this section.

B. As a minimum, all cleaning, surface preparation, painting and coating of surfaces shall conform to the applicable requirements of the Steel Structures Painting Manual;, Volume 2, Systems and Specifications (most recent edition), as published by the Steel Structures Painting Council.

C. The applicator shall be a licensed contractor having practical experience and successful history in the application of the specified products to surfaces and facilities of water and wastewater treatment plants. Upon request, he shall substantiate this requirement by furnishing a written list of references.

D. Surface Preparation

1. Evaluation of surface preparation will be upon comparison with the "Pictorial Surface Preparation Standards for Painting Steel Surfaces," SSPC-VIS 1-89 ASTM Designated D 220-67 (1982) and Standard Methods of Evaluating Degrees of Rusting on Painted Steel Surfaces,": SSPC-VIS 1-89.

2. To facilitate inspection, the Contractor shall on the first day of sandblasting operations, sandblast metal panels (12" x 12" x 1/4") to the degree called for in the specification and

as noted above. Once a sample panel has been approved, it shall establish the quality of all subsequent work by reference. The sample shall then be stored in a dry, sealed plastic container on the job site. Sample panels shall be prepared and approved for each type of sandblasting specified and shall be maintained and utilized by the RPR throughout the duration of sandblasting operations as reference standards of quality. Coatings shall not be applied at temperatures lower than recommended minimums.

E. Thickness and Holiday Checking: Thickness of coatings shall be checked with a non-destructive, magnetic type thickness gauge. All pinholes shall be marked, repaired in accordance with the coating manufacturer's printed recommendations and re-tested. No pinholes or other irregularities will be permitted in the final coating.

F. Inspection Devices

1. The Contractor shall use inspection devices in good working condition for the detection of holidays and measurement of dry-film thickness of protective coatings. The Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dry film thickness gauges and certified instrumentation to test accuracy of holiday detectors.

G. The Contractor shall comply with ambient temperature and humidity requirements for application of coating or paint products on the job site.

H. Warranty Inspection: Warranty inspection shall be conducted during the eleventh month following completion of all coating work. All defective work shall be repaired in strict accordance with this specification and to the satisfaction of the paint manufacturer and the City.

1.04 SUBMITTALS

A. Submit to the Engineer: shop drawings, manufacturer's specifications and data on the proposed paint systems and detailed surface preparation, application procedures and dry film thickness.

B. Schedule of Painting Operations: The Contractor shall submit for approval a complete Schedule of Painting Operations within 30 days after the Notice to Proceed.

C. Certification: Submit certification by the paint manufacturer that the primer used on equipment/materials is compatible with the finish coat paint (see 09902, 1.02 Submittals).

D. One copy of references specified in 1.02 D.1.

E. Test Panels/Samples: At the request of the Engineer, samples of the finished work prepared in strict accordance with these Specifications shall be furnished and all painting shall be equal in quality to the approved samples.

1.05 PRODUCT DELIVERY STORAGE AND HANDLING

A. All painting materials shall be delivered to the project site in unbroken containers, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned, and applied in strict accordance with manufacturer's directions for the applicable materials and surfaces and with the Engineer's approval before using.

B. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes, and no plumbing fixture shall be used for this purpose.

PART 2 - PRODUCTS

2.01 GENERAL

A. All painting materials shall be fully equal to those manufactured by Carboline, Tnemec, Induron or an approved equal. The painting schedule has been prepared on the basis of Carboline, Tnemec, and Induron products (unless otherwise noted) and their recommendations for applications. No other brand will be considered for approval unless sufficient data substantiated by certified tests to demonstrate its equality to the paint(s) specified is submitted in writing to the Engineer for approval.

B. Shop priming shall be done with primers that are certified by the manufacturer to be compatible with the finish paints to be used.

C. No paint containing lead will be allowed.

D. Oil, where indicated shall be pure boiled linseed oil or as specified by the system mfr.

2.02 PAINTING SYSTEMS

A. The following summarizes the painting systems for various types of applications. Table 09900-A outlines, in general, specific job application locations.

B. All colors will be selected by the City/Engineer from color charts supplied by the Contractor.

C. Minimum thickness shall be per manufacturer's recommendations unless a greater thickness is specified.

D. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness in mils (MDFT) per coat noted. The schedule is applicable to existing and proposed surfaces, with the exception that priming for existing surfaces is only required as specified in Paragraph 3.02.

Coat	Carboline/Plasite	Tnemec	Induron
1. Unpainted wood finished shelving, window frames, door frames, doors casework and trim finish with 3 coats of exterior premium Clear Urethane. Sanding or steel wool should be used between coats.			
2. Wood-painted finish (interior or exterior) non-submerged:			
Prime	1 coat Carbocrylic 120, 1.0 - 2.0 mils DFT.	TNEMEC 10-99W Primer, 2.0 to 3-5 DFT.	1 coat AC 303 Exterior Wood Primer, 2.0 - 3.0 DFT
Finish	2 coats Carbothane 139, 2.0 - 3.0 DFT each coat.	2 coats TNEMEC 2H Hi-Build Tneme Gloss, 1.5 to 2.5 DFT	2 coats Armorlux 2500, 1.5 - 2.5 DFT each coat

Coat	Carboline/Plasite	Tnemec	Induron
		each coat.	
3. Interior Non-Submerged Concrete Walls poured or precast, not subject to spray, splash or dampness:			
Prime	1 coat Carbocrylic 3359, 2.0 - 3.0 mils DFT.	TNEMEC Series 6 Tneme-Cryl, 2.0 to 3.0 DFT.	AC 220 Acrylic Eggshell, 2.0 - 3.0 DFT
Finish	1 coat Carbocrylic 3359, 2.0 - 3.0 mils DFT.	TNEMEC Series 6 Tneme-Cryl, 2.0 to 3.0 DFT.	AC 220 Acrylic Eggshell, 2.0 - 3.0 DFT
4. Exterior Non-Submerged Concrete, Masonry, or Stucco above grade:			
Prime	Carboline Masonry Block Filler 80-100 SF/Gallon	TNEMEC 1254 Epoxoblock WB, 100 to 120 SF/Gallon.	AC 220 Acrylic Block Filler, 80 to 100 SF/Gal.
Finish	2 coats Carbocrylic 3359 Acrylic, 2.0 - 3.0 DFT each coat.	2 coats TNEMEC Series 6 Tneme-Cryl, 2.0 to 3.0 DFT, each coat.	2 coats AC 230 Acrylic Eggshell, 2.0 - 3.0 DFT, each coat
5. Exterior Non-Submerged Concrete or Masonry surfaces below grade to be backfilled:			
Prime	N/R	N/R	N/R
Finish	1 coat Bitumastic No. 300 M, 16.0 mils DFT.	TNEMEC Series 46H-413 High Build Tneme-Tar, 14.0 to 20.0 DFT.	Ruff Stuff 2100 Coal Tar Epoxy, 14.0 - 20.0 DFT
6. Interior Non-Submerged Concrete or Concrete Masonry units:			
Prime	Carboline Masonry Block Filler 80 to 100 Sq. Ft./Gallon	TNEMEC 54 Masonary Filler, 80 to 100 Sq. Ft./Gallon	AC 220 Acrylic Block Filler, 80 - 100 Sq. Ft./Gal.
Finish	2 coats Carbocrylic 3359, 2.0 - 3.0 mils DFT per coat.	2 coats TNEMEC Series 6 Tneme-Cryl, 2.0 to 3.0 DFT, each coat.	2 coats AC 230 Acrylic Eggshell, 2.0 - 3.0 DFT each coat
7. Concrete submerged or subject to spray - black (non-potable):			
Prime	N/R	N/R	N/R
Finish	1 coat Bitumastic 300 M, 14.0 - 20.0 DFT.	TNEMEC Series 46H-413 High Build Tneme Tar, 14.0 to 20.0 DFT.	Ruff Stuff 2100 Coal Tar Epoxy, 14.0 - 20.0 MDFT
8. Concrete submerged or subject to spray concrete - Color:			
Prime	1 coat Carboguard 561, 3.0 - 5.0 mils DFT.	TNEMEC Series 20 Pota-Pox, 3.0 to 5.0 DFT.	PE-54 Epoxy Primer, 3.0 - 5.0 DFT.
Finish	2 coats Carboguard 561, 4.0 - 6.0 mils DFT.	2 coats TNEMEC Series 20 Pota-Pox, 4.0 to 6.0 DFT, each coat.	2 coats PE-54 Int./Finish Epoxy, 4.0 - 6.0 DFT, each coat.
	Total: 11.0 to 17.0 DFT	Total: 11.0 to 17.0 DFT	Total: 11.0 - 15.0 DFT
	For potable water application, must be NSF certified and approved color.		

Coat	Carboline/Plasite	Tnemec	Induron
9. Concrete Floors subject to moisture and traffic:			
Prime	1 coat Carboguard 890 (thinned 20%), 3.0 - 5.0 mils DFT.	TNEMEC Series 66 Hi-Build Epoxoline, 3.0 to 5.0 DFT.	Armorguard Polyamide Epoxy, 3.0 - 5.0 DFT
Finish	2 coats Carboguard 890, 4.0 - 6.0 mils DFT each coat, with non-skid aggregate.	2 coats TNEMEC Series 66 Hi-Build Epoxoline, 4.0 to 6.0 DFT each coat, with non-skid aggregate.	2 coats Armorguard Polyamide Epoxy, 4.0 - 6.0 DFT each coat, with non-skid aggregate
	Total: 15.0 MDFT (minimum)	Total: 15.0 MDFT (Min.)	Total: 15.0 MDFT (Min.)
10. Concrete subject to acid spills and fumes:			
Prime	Plasite 9029 Filler as required to fill voids in the concrete.	TNEMEC 215 Surfacing Epoxy as required to fill and sand.	1 coat Key Vinyl Ester Coating, 10.0 - 20.0 DFT.
Finish	2 coats Plasite Plasguard 4006, 15.0 mils DFT each coat.	1 coat TNEMEC Series 120-5002, 12.0 to 18.0 DFT and 1 coat Series 120-5001, 12.0 to 18.0 DFT.	1 coat Key Vinyl Ester Coating, 20.0 - 40.0 DFT
	Total: 30.0 MDFT plus primer	Total 30.0 MDFT plus primer	Total: 30.0 MDFT (Min.)
11. Interior Cement Plaster or Gypsum Dry Walls:			
Prime	1 coat Carbocrylic 120, 1.0 - 2.0 mils DFT.	TNEMEC 151 Elasto-Grip PVA Sealer, 1.0 to 2.0 DFT.	1 coat Polyfill Epoxy Block Filler, 3.0 - 4.0 MDFT
Finish	2 coats Carboguard 890, 4.0 - 6.0 mils DFT each coat.	2 coats TNEMEC Series 66 Hi-Build Epoxoline, 4.0 to 6.0 DFT, each coat.	2 coats Armorguard Polyamide Epoxy, 3.0 - 5.0 MDFT each coat
	Total: 9.0 - 14.0 mils DFT	Total: 9.0 - 14.0 mils DFT	Total: 9.0 - 14.0 mils DFT
	Note: Laboratory areas shall receive special titanium base epoxy paint containing no other metals that may affect testing procedure.		
12. All Submerged Ferrous Metals and Ferrous Metals subject to submergence or splashing (for contact with non-potable water) - Black:			
Prime	N/R	N/R	N/R
Finish	1 coat Bitumastic 300 M, 16.0 - 20.0 mils DFT.	TNEMEC Series 46H-413 Tneme-Tar, 16.0 to 20.0 DFT.	Ruff Stuff 2100 Coal Tar Epoxy, 16.0 - 20.0 DFT
13. All Submerged Ferrous Metals and Ferrous Metals subject to submergence or splashing (for contact with potable water) - Color - must be NSF certified and approved color:			
Prime	1 coat Carboguard 561, 3.0 - 5.0 mils DFT.	TNEMEC Series 20 Pota-Pox, 3.0 to 5.0 DFT.	1 coat PE-54 Epoxy Primer, 3.0 - 5.0 DFT
Finish	2 coats Carboguard 561, 4.0 - 6.0 mils DFT each.	2 coats TNEMEC Series 20 Pota-Pox, 4.0 to 6.0 DFT each.	2 coats PE-54 Int./Finish, 4.0 - 6.0 DFT each

Coat	Carboline/Plasite	Tnemec	Induron
	Total: 11.0 - 17.0 mils DFT.	Total: 11.0 - 17.0 mils DFT.	Total: 11.0 - 17.0 mils DFT.
14. Interior Non-Submerged Ferrous Metal:			
Prime	1 coat Carboguard 893, 3.0 - 5.0 mils DFT.	TNEMEC Series 66-1255 Hi-Build Epoxoline, 3.0 to 5.0 DFT.	P-14 Armorguard Primer, 3.0 - 5.0 DFT
Finish	2 coats Carboguard 890, 4.0 - 6.0 mils DFT each.	2 coats TNEMEC Series 66 Hi-Build Epoxoline, 4.0 to 6.0 DFT each.	2 coats Armorguard Polyamide Epoxy, 4.0 - 6.0 DFT each
	Total: 11.0 to 17.0 mils DFT.	Total: 11.0 to 17.0 DFT.	Total: 11.0 to 17.0 DFT.
15. Exterior Non-Submerged Ferrous Metals:			
Prime	1 coat Carboguard 893, 3.0 - 5.0 mils DFT.	TNEMEC Series 66 Hi-Build Epoxoline, 3.0 to 5.0 DFT.	1 coat P-14 Armorguard Primer, 3.0 - 5.0 DFT
Inter.	1 coat Carboguard 890, 4.0 - 6.0 mils DFT.	TNEMEC Series 66 Hi-Build Epoxoline, 4.0 to 6.0 DFT.	1 coat Armorguard Polyamide Epoxy, 2.0 - 3.0 DFT
Finish	1 coat Carbothane 134 HG, 2.0 - 3.0 mils DFT.	TNEMEC Series 73 Endurashield, 2.0 to 3.0 DFT.	1 coat Indurethane 5500, 2 - 3 DFT
	Total: 9.0 - 14.0 mils DFT.	Total: 9.0 - 14.0 mils DFT.	Total: 9.0 - 14.0 mils DFT.
16. Ferrous Metals - High Temperature (over 150° F):			
Prime	1 coat Carbozinc 11, 2.0 - 3.0 mils DFT.	TNEMEC Series 90E-92 Tneme-Zinc, 2.0 to 3.5 DFT	Armorlux Aluminum, 1.0 - 2.5 DFT
Finish	1 coat Carboline Thermaline 4700 aluminum, 1.5 mils DFT.	High Heat Topcoat by others	2 coats Armorlux Aluminum, 1.0 - 2.0 DFT each.
17. Copper and Bronze Piping:			
Prime	1 coat Carboline Rustbond PS, 1.0 - 2.0 mils DFT.	TNEMEC Series 66, 3.0 to 5.0 DFT.	1 coat Vinyl Wash Primer, 1 - 2 DFT.
Finish	1 coat Carbothane 134 HG, 2.0 - 3.0 mils DFT.		1 coat Indurethane 5500 2.0 to 3.0 DFT
	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.
18. Galvanized Metals:			
Prime	1 coat Carboline Rustbond PS, 1.0 - 2.0 mils DFT.	TNEMEC Series 66 Hi-Build Epoxoline, 3.0 to 5.0 DFT.	1 coat Vinyl Wash Primer, 1 - 2 DFT.
Finish	1 coat Carbothane 134 HG, 2.0 - 3.0 mils DFT.		1 coat Indurethane 5500 2.0 to 3.0 DFT
	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.
19. Stainless Steel:			

Coat	Carboline/Plasite	Tnemec	Induron
Prime	1 coat Carboline Rustbond PS, 1.0 - 2.0 mils DFT.	TNEMEC Series 66 Hi-Build Epoxoline, 3.0 to 5.0 DFT.	1 coat Vinyl Wash Primer, 1 - 2 DFT.
Finish	1 coat Carbothane 134 HG, 2.0 - 3.0 mils DFT.		2 coats Armorlux Aluminum, 1.0 - 2.0 DFT each.
	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.
20. Plastic Piping: Coating not required except as noted. Exposed piping shall be painted as required in the color coding schedule.			
21. Aluminum:			
Prime	1 coat Carboline Rustbond PS, 1.0 - 2.0 mils DFT.	TNEMEC Series 66 Hi-Build Epoxoline, 3.0 to 5.0 DFT.	Armorlux Aluminum, 1.0 - 2.5 DFT
Finish	1 coat Carbothane 134 HG, 2.0 - 3.0 mils DFT.		2 coats Armorlux Aluminum, 1.0 - 2.0 DFT each.
	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 5.0 mils DFT.	Total: 3.0 - 6.5 mils DFT.

22. Parking stall lines on asphalt pavement: Prime with approved reflective pavement marking paint, white or yellow in color, conforming to AASHTO standards for materials and installation.

23. Steel Pipe (exterior only): See applicable ferrous metal system above.

24. Ductile Iron Pipe: See applicable ferrous metal system above.

E. Any surfaces not specifically named in the Schedule and not specifically excepted shall be prepared, primed and painted in the manner and with materials consistent with these Specifications. The Engineer shall select which of the manufacturer's products, whether the type is indicated herein or not, shall be used for such unnamed surfaces. No extra payment shall be made for this painting.

2.03 EXTRA PAINT: Furnish one sealed pint can of each type and each color of paint used, properly marked for future use by City/Engineer.

PART 3 - EXECUTION

3.01 GENERAL

A. All coating and painting shall conform to the applicable requirements of the Steel Structures Painting Council Manual (most recent edition). Any material applied upon improperly prepared surfaces shall be removed and redone to the satisfaction of the Engineer at the sole expense of the Contractor.

B. All work shall be done by skilled craftsmen who are qualified to perform the required work and shall be done in a manner comparable with the best standards of practice found in that trade.

C. The Contractor shall provide a supervisor to be at the work site during blast cleaning and coating operations. The supervisor shall have the authority to sign all change orders, coordinate the work and make other decisions pertaining to the fulfillment of their contract.

D. All dust, dirt, oil, grease or any contaminants which would affect the adhesion or durability of the finish coating must be removed before painting by cleaning per SSPC-SP-1. Slag and weld metal accumulation and spatters shall be removed by chipping and grinding. All sharp edges shall be peened, ground or otherwise blunted as required and directed by the RPR.

E. The Contractor's coating and painting equipment shall be designed and suitable for the application of the specific materials herein specified. Equipment shall be maintained in condition required to obtain the specified coating application. Compressors shall have suitable traps and filters installed to remove water and oils from the air. The Contractor's equipment shall be subject to the approval of the RPR based on the manufacturer's data.

F. Sandblasting and priming shall be completed on any particular area, and the application of the primer shall follow immediately after surface preparation and cleaning prior to formation of any form of corrosion. If the surface is not primed within 24 hours, preparation shall be repeated.

G. Prior to assembly, all surfaces that will be made inaccessible after assembly, shall be prepared as specified herein and shall receive the paint or coating system as specified herein.

H. Coating shall not be applied to wet or damp surfaces and shall not be applied in inclement weather. Do not apply when the surface temporary is less than 5°F above the dew point. Dew or moisture condensation should be anticipated and if such conditions are prevalent, coating should be delayed until the surfaces are dry. Further, the day's coating should be completed well in advance of when condensation will occur, in order to permit the film a sufficient drying time prior to the formation of moisture.

3.02 SURFACE PREPARATION

A. General: The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1-82): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning of similar materials and methods, which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2-82): Removal of loose rust, loose mill scale and loose paint to degree specified by hand chipping, scraping, sanding and wire brushing.

3. Power Tool Cleaning (SSPC-SP3-82): Removal of loose rust, loose mill scale and loose paint to degree specified by power brushing, power impact tools or power sanders.

4. Commercial Blast Cleaning (SSPC-SP6-82): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

5. Near-White Blast Cleaning (SSPC-SP10-82): Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.

B. The abrasive used in blast cleaning shall be that which will produce a height profile in accordance with the recommendations of the manufacturer of the protective coating which is to be applied to the surface being cleaned.

C. Field blast cleaning for all surfaces shall be accomplished by dry sandblasting method unless otherwise directed.

D. At all times during the blast cleaning operations, adequate means shall be employed to absolutely insure that existing protective coatings shall not be exposed to abrasion from blast cleaning operations.

E. The Contractor shall at all times keep the area of his work in reasonably clean condition and shall not permit blasting materials to accumulate in an uncontrolled manner such as to constitute a nuisance or hazard to the satisfactory prosecution or the work (or operation of the existing facilities).

F. All blast cleaned surfaces shall be carefully dried and cleaned prior to application or specified coatings. No coatings or paint shall be applied over damp or moist surfaces.

G. All welds shall be neutralized with a suitable solvent or other acceptable cleaner compatible with the specified Coating System materials.

H. Specified Surface Preparation: Surface preparation for the specific Service Condition shall be as follows:

1. Ferrous Metals Subject to Corrosive Moisture or Atmosphere and Condensation: All surfaces shall be field sand blasted in conformance with Steel Structures Painting Council Specification SSPC-SP6 (Near-white blast cleaning).

2. Ferrous Metals Submerged or Subject to Spray and Splash: All surfaces shall be field sand-blasted in conformance with Steel Structures Painting Council Specification SSPC-SP10 (Near-white blast cleaning).

3. Ferrous Metals (High Temperature): All surfaces shall be field sand-blasted in conformance with Steel Structures Painting Council Specification SSPC-SP10 (Near-white metal).

4. Non-ferrous and Galvanized Metals: All surfaces shall be field brush-blasted or solvent-cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP7 or SP1.

5. Masonry and Concrete: All surfaces shall be thoroughly cleaned by sandblasting, wire brushing or other suitable methods; removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly-bonded concrete. Cracks and voids shall be repaired or filled with grout, mixed and placed in strict accordance with manufacturer's instructions. In general, final surface shall be reasonably smooth and free to voids, cavities, dirt, dust, oils, grease, laitance or other contaminants. Concrete subject to submergence shall be brush-blasted.

6. Plastic pipe shall be lightly sanded and washed clean.

7. Wood Surfaces

    a. These surfaces, other than stained or natural finish, shall be primed and finish-coated as specified. Wood surfaces to be painted shall be cleaned of dirt, oil, and other foreign substances with mineral spirits, scrapers, and/or sandpaper. Finish surfaces exposed to view shall be made smooth by sanding. All wood items to be painted and in contact with or built into concrete, masonry or plaster shall be back primed. Small, dry seasoned knots shall be surface scraped and thoroughly cleaned, and shall be given a thin coat of knot sealer before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or if still soft, shall be removed with mineral spirits or turpentine and the resinous area thinly coated with knot sealer. After priming, all holes and imperfections in finish surfaces shall be filled with putty or plastic wood-filler colored to match the finish coat, allowed to dry, and sanded smooth. Unless otherwise authorized, painting shall proceed only when the moisture content of the wood does not exceed 12 percent as measured by a moisture meter.

    b. Stained or Natural Finish: Interior wood surfaces to receive stained or natural finish shall be properly prepared to the approved shade and lightly sanded. Oak, and other open-grained wood, shall be given the same treatment and, in addition, shall be given a coat of paste wood filler not less than eight hours after the application of the stain. Excess filler shall be removed and the surface then sanded smooth. Each coat shall be lightly sanded prior to application of subsequent coat.

8. Exposed Pipe: Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed. After installation all exterior, exposed flanged joints shall have the gap between adjoining flanges sealed with a single component Thiokol caulking to prevent rust stains.

9. Shop-Finished Surfaces: All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged area immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be "Hand Cleaned" and then touched up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch up in the opinion of the Engineer shall be repainted. Cut edges of galvanized sheets and exposed threads and cut ends of galvanized piping, electrical conduit, and metal pipe sleeves, not to be finish painted, shall be "Solvent Cleaned" and primed.

10. Plaster Surfaces: These surfaces shall be clean, free from grit, loose plaster, and surface irregularities, and shall have an instrument-measured moisture content not exceeding eight (8) percent.

11. Aluminum embedded or in contact with concrete must be painted with one shop coat of primer followed by one heavy coat of aluminum pigmented asphalt paint.

3.03 PREPARATION OF SURFACES - EXISTING FACILITIES: All existing facilities to be painted shall be thoroughly washed with a high strength chlorine solution or a trisodium phosphate solution to provide a surface suitable for finish painting. Any corrosion of ferrous surfaces shall be removed by wire brushing or sandblasting, and the area primed with the appropriate primer specified in the paint schedule.

3.04 WORKMANSHIP

A. General

1. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular re-paint condition will be compatible with the existing painted surface. Sample re-painted areas on the actual site will be required to insure this compatibility. Finished repainted areas shall be covered by the same guarantee specified for remainder of work.

2. Protection of equipment, fittings, and accessories shall be provided throughout the painting operations. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc., before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.

3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture, however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

4. All safety equipment shall be painted in accordance with OSHA Standards.

5. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint. No thinner shall be added after proper mixing of the paint materials.

6. Only skilled painters shall be used on the work and specialists shall be employed where required.

B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job.

All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule.

2. Equipment which is customarily shipped with a baked enamel finish or with a standard factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coats or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish.

C. Field Painting

1. All painting at the site shall be designated as Field Painting.

2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 50°F, in dust-laden air, when rain or snow is falling, when relative humidity exceeds manufacturer's recommendation, or until all traces of moisture have completely disappeared from the surface to be painted.

3. Each application of paint or coating shall be applied at the recommended thickness, free of sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Paint shall be sharply cut to lines. Finished surfaces shall be free from defects of blemishes.

4. Protective coverings or drop cloths shall be used to protect floors, fixtures and equipment. Care shall be exercised to prevent paint or coating from being spattered onto surfaces which are not to be painted. Surfaces from which such materials cannot be removed satisfactorily shall be painted or repainted, as required to produce a finish satisfactory to the Engineer.

5. Successive coats of paint shall be tinted so as to make each coat easily distinguishable from each other with the final undercoat tinted to the approximate shade of the finished coat.

6. All welds and irregular surfaces shall receive a brush coat of the specified product prior to application of the first complete coat.

7. Finish surfaces shall not show brush marks or other irregularities. Under coats shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted and all exterior trim shall be back-primed before installation.

8. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. All exterior concrete and masonry painting shall be performed in one continuous manner structure by structure. Materials subject to weathering shall be prime coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.

9. All materials shall be brush painted unless spray painting is specifically approved by the Engineer. If spray painting is approved, Contractor shall accept all responsibility for any damage caused by overspray and/or drifting paint mist.

10. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.

11. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

12. The aluminum work noted on the Drawings or in the Painting Schedule except all structural walkways, supports, railings, toe-boards, grating, and checkered plate shall be field painted.

3.05 CLEANUP

A. The premises shall at all times be kept free from accumulation of waste material and rubbish caused by employees or work. At the completion of the painting remove all tools, scaffolding, surplus materials, and all rubbish from and about the buildings and leave work "broom clean" unless more exactly specified.

B. Upon completion, remove all paint where it has been spilled, splashed, or splattered on all surfaces, including floors, fixtures, equipment, furniture, etc., leaving the work ready for inspection.

3.06 COLOR CODING FOR PIPES AND EQUIPMENT (when required on drawings or by specific note shall be as follows, otherwise shall be one color as determined by the City)

A. Color coding is required and shall consist of color code painting and identification of all exposed conduits and pipelines for the transport of gases, liquids and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and all operating accessories which are integral to be whole functional mechanical pipe and electrical conduit system. The color coding schedule shall be in accordance with Table 09900-A.

B. All hangers and pipe support floor stands shall be painted. The system shall be painted up to and including the flanges attached to the mechanical equipment. Colors shall be as selected by the City/Engineer.

C. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to but not including, the fixed flanges or connections on the equipment.

D. The color code establishes, defines and assigns a definite color for each category of pipe. Pipelines which are not listed on the Paint Color Code Schedule shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract.

E. All pipes, equipment, and accessories shall be painted according to Paint Color Code Schedule attached. All pipes shall have 6" long color coded flow arrows with letters defining its function (i.e., potable water, air, sludge, etc.).

3.07 FABRICATED EQUIPMENT

A. Unless otherwise indicated, all fabricated equipment shall be shop primed and shop or field finished.

B. All items to be shop primed shall be thoroughly cleaned of all loose material prior to priming. If, in the opinion of the Engineer, any prime coating shall have been improperly applied or if material contrary to these Specifications shall have been used, that coating shall be removed by sandblasting to white metal and reprimed in accordance with these Specifications.

C. All shop prime coats shall be of specified materials and applied in accordance with these Specifications. The Contractor shall remove any prime coats not in accordance with these Specifications by sandblasting and apply the specified prime coat at no additional cost to the City/Engineer.

D. Shop primed surfaces shall be cleaned thoroughly and retouched with the specified primer before the application of successive paint coats in the field.

E. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer when approved by the Engineer. All pumps and motors shall be repainted after installation.

F. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.

G. If, in the opinion of the Engineer, a shop finish coat does not give the protection quality of other work of similar nature, the Contractor shall apply the coat or coats of paint as directed by the Engineer to accomplish the desired protection quality.

H. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned by the Contractor.

(Remainder of Page Left Blank Intentionally.)

TABLE 09900-A

PAINT SCHEDULE

STRUCTURE	ITEM	PAINT SYSTEM NO.
Wetwell	Interior	Per Section 03932
	Exterior	4
	Interior Metals	13, 18 or 03932
	Exterior Metals	15, 17, 18
Pump Building Exterior	Block	4 (See also Section 09220)
	Wood	N/A
	Metals	15, 17, 18
Pump Building Interior	Block Walls	6
	Wood	2
	Metals	14, 17, 18
	Ceilings	6
	Floors	9
Miscellaneous	Above Grade Ferrous Metals	15

NOTES:

1. All new construction shall be painted unless specifically listed otherwise in paragraph 1.01 D or in Table 09900-A.

2. All existing finishes damaged or relocated existing equipment incorporated into the Work shall be repainted.

Table 09900-B
Paint Color Code Schedule
(Color shall match existing, where applicable)

Equipment and Materials	Paint Color	Code Label
Chlorine Gas	Yellow	CG
Chlorine Solution	Yellow w/brown Bands	CS
Chlorine Liquid	Yellow w/Alum. Bands	CL
Compressed Air	Black	CA
Potable Water	Blue	PW
Reclaimed Water	Purple	RW
Non-Potable Water	Lt. Green	PEW
Drains	Battleship Grey	D
Electrical Conduit (above 220 volts)	Black w/Yellow Bands	EC
Electrical Conduit in MCC	Match Existing	EC
Return Activated Sludge	Medium Brown	RAS
Raw Sewage Piping	Dark Green	RS
Primary and Digester Sludge	Dark Brown	SL
Partially Treated Effluent	Medium Green	OE
Completely Treated Effluent	Light Green	TE
Electrical Motors, Blower	White	N/A
Electrical Pumps, Compressors	Battleship Grey	N/A
Pipe Hangers	Match Piping	N/A
Waste Activated Sludge	Light Brown	WAS
Scum Waste	Dark Brown	SCM
Clarified Effluent	Medium Green	CE
Plant Recycle	Medium Green	PR
Fuel Oil Vent	Red	FOV
Fuel Oil Return	Red	FOR
Fuel Oil Supply	Red	FOS
Filter Influent	Medium Green	FI
Filter Effluent	Light Green	FE
Backwash	Patio Green	BW
Pretreatment Effluent	Dark Green	PRE
Vent	White	V
Fire Sprinkler Piping	Blue	FS
Dirty Backwash Piping	Dark Green	DBW
Caustic Soda	Orange w/White Bands	COS
Filter Effluent	Light Green	FE
Sump Pump Discharge	Battleship Grey	SPD
Waste	Dark Green	W
Thickened Sludge	Brown	TS
Reuse Hot Water Supply Return	Green w/Red Bands	HWS
Reuse Hot Water Return	Green w/Red Bands	HWR
L.P. Gas	Red	LPG
Cationic Polymer Solution	Aluminum	POS
Liquid Polymer	Aluminum	POL
Methane Gas	Orange	MEG
Peroxide	Orange w/Green Band	PER
Bleach	Orange w/Yellow Band	BL
Fire Hydrant (Potable Water)	City Standard	N/A
Fire Hydrant (PEW)	City Standard	N/A
Safety Barrier Post	Orange	N/A
Acid	Orange w/Black Band - Chemical Name	
Buildings	To Be Selected by City/Engineer	As Noted
Tanks	To Be Selected by City/Engineer	As Noted

Key to Classification of Predominant Colors for Piping		Color of Letters for Stenciling
(F) Fire Protection	Red	White
(D) Dangerous	Yellow	Black
	Orange	Black
(S) Safe	Green	Black
	White	Black
	Black	White
	Light Gray	Black
	Dark Gray	White
	Aluminum	Black
(P) Protective	Blue	White

Width of color bands and letter size shall conform to the following schedule:

Outside Diameter of Pipe or Covering (Inches)	Size of Legend Letters (Inches)	Width of Color Band (Inches)
3/4 to 1 1/4	1/2	8
1 1/2 to 2	3/4	8
3 1/2 to 6	1 1/4	12
8 to 10	2 1/2	24
Over 10	3 1/2	32

END OF SECTION

SECTION 11210

PUMPS - GENERAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish all labor, materials, equipment, and incidentals required to install complete and ready for operation all pumps specified in this Section.

B. General Design: Refer to respective sections of this Subdivision.

C. Related Sections: The following sections shall be effective in addition to this section when referenced below and included in the project documents.

1.02 QUALITY ASSURANCE

A. Qualifications: The pumping units specified herein are to be standard pumping units for the intended service and shall be the product of a fully experienced, reputable and qualified manufacturer of the types of pumps to be furnished. The manufacturer shall have a successful record of operation and manufacturing for a minimum of five (5) years prior to bid date. Manufacturers shall supply the Engineer with previous installation details of at least three (3) successful operations of a similar nature for not less than five (5) years.

B. Warranties and Guarantees:

1. All equipment supplied under this Section shall be warranted for a period of one (1) year by the manufacturer. Warranty period shall commence on substantial completion as outlined in Division 01001.

2. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced at no expense to the Owner.

C. Equipment Manufacturer: (Refer to respective sections of this Subdivision). The naming or reference to a specific manufacturer does not indicate that the manufacturer's standard equipment is acceptable in lieu of the specified component features. This reference is only an indication that the named manufacturers may have the capability of supplying the equipment as specified.

D. Standards:

1. Hydraulic Institute of Standards
2. NEMA
3. NEC
4. AWWA

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. The Contractor shall submit the following to the Engineer for approval:

    a. Manufacturer's literature, illustrations, and applicable data for the individual pumps, including the total weight of the equipment and the weight of components.

    b. Manufacturer's certified curves illustrating pump characteristics of head, discharge, brake horsepower, efficiency, required net positive suction head, and allowable suction lift . Design conditions shall be plotted on curves.

    c. The shop drawings shall include details of pump assembly, installation layouts, procedures, motor control wiring diagrams, types of materials used in pump construction, details on all pump accessories, and dimensions of major components.

    d. The total weight of the equipment and the weight of components.

    e. A complete total bill of materials for all equipment.

    f. A list of manufacturer's recommended spare parts to be supplied with the manufacturer's current price for each item. Include O-rings, seals, etc. on the list. List bearings by the bearing manufacturer's numbers only.

    g. The following data shall be provided on the drive motors: rpm at full load, frequency, voltage, full load current, code and design letter, efficiency, horsepower, number of phases, time rating, temperature rise, service factor, and bearing life rating. The submittal shall include motor manufacturer's recommended lubrication requirements.

    h. Variable speed vertical pump applications shall include a pump structural frequency analysis and certified calculations.

B. Operation and Maintenance Manuals: For all pumps furnished under this Section, the Contractor shall submit operation and maintenance manuals to include the following:

    1. Equipment function.

    2. Description.

    3. Normal and limiting operating characteristics.

    4. Installation instructions (assembly, alignment and adjustment procedures).

    5. Operation instructions (normal start-up and shut-down procedures, normal operating conditions and emergency situations).

    6. Lubrication and maintenance instructions.

    7. Troubleshooting guide.

    8. Parts list and predicted life of parts subject to wear.

    9. Drawings - cross-sectional view, assembly and wiring diagrams.

10. Performance curves.

C. Factory Performance Test Data

1. After acceptance of pump shop drawings, factory performance test data will be submitted for approval on each pumping unit. Duplicate units require only one test, unless otherwise specified under the specific pump specification.

2. If records exist on test of similar units tested within the last two (2) years, certified copies may be submitted instead of actual tests, unless otherwise specified under the specific pump specification.

3. If specified, test shall be witnessed and certified by a registered professional engineer not employed by the pump manufacturer.

4. Tests shall be in accordance with the standards of the Hydraulic Institute including head, capacity, brake horsepower and pump efficiency.

1.04 FIELD OPERATING INSTRUCTIONS: The Contractor shall supply the services of a qualified factory-trained service representative for a period specified under the individual equipment specifications. The representative shall inspect the completed equipment installation to ensure that it meets with the manufacturer's recommendations. Any adjustments or modifications shall be made, at no additional cost to the Owner, to place the equipment in trouble-free operation. The factory representative will then instruct the operational personnel in the proper maintenance and operation of the equipment.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is complete and the units and equipment are ready for operation.

B. All equipment and parts must be properly protected against any damage during a prolonged period at the site as specified in the Specific provisions.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage, and handling.

G. Each box or package shall be properly marked to show its net weight in addition to its contents.

PART 2 - PRODUCTS

2.01 GENERAL

A. The equipment covered by these Specifications shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown on the Drawings.

B. All parts shall be so designed and proportioned as to have liberal strength and stiffness, and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustment.

C. Pump bases shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by the Contractor and conform to the recommendations and instructions of the equipment manufacturer. Anchor bolts, nuts, and washers shall be 18-8 grade Stainless Steel. Grouting under bases after the equipment is set is included as work under this Section. Pumps and pump bases shall have adequate provisions to collect drainage and conduct it away to nearest drain.

D. Data Plates:

1. Stainless steel pump nameplates giving the name of the manufacturer, the rated capacity, head, speed and any other pertinent data shall be attached to each pump.

2. Stainless steel motor nameplates giving the name of the manufacturer, serial number, model number, horsepower, speed, voltage, amperes and all other pertinent data shall be attached to each motor.

E. The nameplate ratings (not including a combined service factor) for the motors shall not be exceeded, nor shall the design service be reduced when its pump is operating at any point on its characteristic curve at maximum speed.

F. All pumps shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

2.02 PUMP MOTORS

A. Pump motors shall be compatible with the controller/drive system provided. The pump/motor supplier shall have single-source responsibility to the Owner for the VFD/controller/drive system provided and shall coordinate and verify the compatibility of motor and VFD system. A written statement attesting to the pump/motor/drive compatibility shall be provided with shop drawing submittal to the engineer/Owner.

B. Unless otherwise specified, all installed pumping equipment shall not produce noise levels greater than 85 dBA when measured 3 feet from the noise source, nor greater than the recommended limits of the respective manufacturer's or industrial standards. Equipment which exceeds these noise level limitations shall be removed from the project and replaced with acceptable equipment or may be modified by the Contractor using methods which do not interfere with the normal operation and maintenance of the equipment, all at no additional cost to the Owner.

2.03 VIBRATION

A. Pump supplier shall provide a baseline vibration analysis for alll variable speed pump systems and provide a record of the results in the O&M manual.

B. The pump supplier/manufacturer is to verify the absence of critical harmonic frequencies and provide documentation of same..

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

B. The Contractor shall submit a completed "Check-out Memo" from the equipment manufacturer certifying that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

C. Pump bases shall be rigidly and accurately anchored into position, and all necessary foundation bolts, plates, nuts, and washers shall be furnished and installed by the Contractor. Anchor bolts shall be set by the Contractor in accordance with the manufacturer's recommendations.

3.02 FIELD PAINTING

A. Field painting is specified under Division 9. The primer and paint used in the shop shall be products of the same manufacturer as the field paint to assure compatibility.

B. All nameplates shall be properly protected during painting.

3.03 INSPECTION AND TESTING

A. After all pumps have been completely installed, the Contractor shall conduct, in the presence of the Engineer, such field tests as are necessary to indicate that pump efficiency and discharge conform to the Specifications. Field tests shall be performed for all pumps included under this Division. The Contractor shall supply all oil, grease, electric power, water or wastewater and all other material necessary to complete the field tests.

B. If field testing of pump performance does not conform to the Specifications, the pumping equipment may be modified by the Contractor to correct such deficiencies, or pumps shall be removed and replaced with pumps which satisfy the conditions specified, all at no additional cost to the Owner.

C. The components of each lubricating system shall be completely tested by the Contractor in the presence of the Engineer. Any component parts which are damaged as a result of testing or which fail to meet the requirements of this Specification shall be replaced, reinstalled, and retested at the Contractor's expense.

D. The pumps and motors shall be designed and constructed to avoid the generation of objectionable noise or vibration. The sound pressure level at full load shall not exceed 85 dBA above 300 cycles when measured at a point not exceeding 3 feet from the motor.

Mufflers or external baffles will not be accepted. When operating at any point between zero flow and design flow, the vibration measured in a horizontal plane at the top of the motor shall not exceed two (2) mils displacement from peak to peak.

E. Field Testing

1. Upon completion of all the mechanical work, the Contractor shall conduct testing as specified herein to demonstrate that the equipment performs in accordance with all specifications.

2. The Contractor shall perform initial testing of the equipment insuring to himself that the tests listed in the Demonstration Test paragraph below can be satisfactorily completed.

3. The Demonstration Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:

    a. That all units have been properly installed and are in correct alignment.

    b. That the units operate without overheating or overloading any parts and without objectional vibration.

    c. That there are no mechanical defects in any of the parts.

    d. That the pumps can deliver the specified pressure and quantity.

    e. That the pump controls perform satisfactorily.

    f. That noise levels are at acceptable levels (below 85 dBA).

4. In the event that the equipment does not meet the Demonstration Test, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which he deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

5. The Owner will pay the salaries of the personnel selected by the Owner for operation of the equipment. Payment of all other salaries, public utility services, and operating expenses shall be borne by the Contractor for the test period and any additional test period required.

END OF SECTION

SECTION 11211

HIGH SERVICE PUMPS
(SPLIT-CASE)

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: The work included under this section consists of furnishing and installing three (3) horizontal split-case High Service Pumps with motors as described herein, as listed in Table 11211SC-A, and as shown on the Contract Drawings.

1.02 QUALITY ASSURANCE

A. Comply with Section 11210

B. The pumps and motor supplier shall review submittals for pump controls and VFD drives and determine if the proposed equipment is suitable for the intended pumping application and service conditions. The pump supplier shall share responsibility for the drives and controls to the pumping equipment, to insure that all equipment is compatible.

C. All pumps shall be factory tested and certified pump performance curves shall be submitted. Performance curves shall include head, capacity, brake horsepower, and pump efficiency. In addition, pumps shall be hydrostatically tested for one and one half times the working pressure.

D. Pumps shall be held at shut-off head for at least one minute and shall be run at their maximum rating point for at least 30 minutes. The test shall also establish that the pump is free from overheating, cavitation, and excessive vibration over the pumps entire operating range. Vibrometer readings shall be performed during the tests and the results recorded. Pumps shall not be shipped prior to approval of the factory tests by the Engineer.

1.03 SHOP DRAWING SUBMITTALS: Comply with Section 11210.

1.04 OPERATING INSTRUCTIONS

A. Comply with Section 11210.

B. A factory representative of the pump manufacturer who has complete knowledge of the proper operation and maintenance of pumps supplied shall be provided for one (1) day to instruct representatives of the Owner and the Engineer on proper operation and maintenance.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with Section 11210.

B. All equipment items shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. All equipment and parts must be properly protected against any damage during a prolonged period at the site.

D. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

1.06 WARRANTIES AND GUARANTEES: The pump manufacturer shall warrant the pumps being supplied to the Owner against defects in workmanship and materials for a period of one (1) year from the time of substantial completion or (2) years from time of delivery to the site. If any part of the equipment should fail during the warranty period, it shall be replaced and restored to service at no expense to the Owner.

1.07 SPECIAL TOOLS AND SPARE PARTS

A. General: Comply with Section 11210.
B. Supply spare parts and tools listed in this section.

PART 2 - PRODUCTS

2.01 GENERAL

A. The equipment covered by these Specifications is intended to be standard pumping equipment of proven ability as manufactured by reputable companies having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall perform satisfactorily when installed as shown on the Drawings in accordance with the conditions outlined in Table 11211SC-A.

B. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness, and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustments.

C. Brass or stainless steel nameplates giving the name of the manufacturer, serial number, model number, rated capacity, head, speed, and other pertinent data shall be attached to each pump.

D. Brass or stainless steel nameplates giving the name of the manufacturer, serial number, model number, horsepower, speed, voltage, amperes, and other pertinent data shall be attached to each motor.

E. Pumps and motors shall be mounted on a common steel base plate which shall be rigidly and accurately anchored into position. All necessary anchoring bolts, plates, nuts, and washers shall be furnished and installed by the Contractor.

2.02 EQUIPMENT

A. Horizontal Split Case Pumps

1. Casing

a. Type: Horizontal split case, single stage, double suction

b. Material: Cast iron ASTM 48-64 Class 40

c. Nozzles: Flanged suction and discharge nozzles cast integral with lower casing half and drilled 125 lb. ANSI.

d. Feet: Heavy duty casing feet cast integral with lower casing half and located immediately adjacent to the suction and discharge flanges.

e. Horizontal seal: Pre-cut gasket

f. Casing Ring: Bronze, flat face SAE 63

g. Vent: 1/2-inch P.T. vent at top of upper casing.

h. Seal Water: Casing shall include taps for seal water supply and drain and brass seal water tubing.

i. Hydrostatic testing: One and one-half times the working pressure.

2. Impeller

a. Type: Double-suction enclosed, dynamically and hydraulically balanced.

b. Material: C95800 Nickel/Aluminum Bronze

c. Key: Stainless Steel key shall firmly secure the impeller to the shaft.

d. Impeller Ring: ASTM B584 Bronze, SAE 40

3. Shaft Sleeve

a. Material: Bronze, ASTM B148 or ASTM B584 (for Seals) or 440 SS (for Packing)

b. Type: Renewable, extending through stuffing box, threaded against shaft rotation.

c. Gaskets: Buna-N O-rings at impeller end.

4. Shaft

a. Material: Alloy-steel, ASTM 4340 or ASTM 1040

b. Diameter: Shaft shall be adequately sized and designed to minimize deflection to 0.002. The shaft shall have the same nominal diameter through the shaft sleeve.

5. Bearings

a. Type: Single row inboard and double row outboard, deep groove type ball bearings.

b. Size: Designed for a minimum of 250,000 hours calculated minimum L1O rated bearing life at shut off per ANSI B3.15.

c. Brackets: Cast iron with oil lubrication provisions.

d. Cover and Cap: Cast iron ASTM 48-64 Class 30.

6. Seal

a. Type: John Crane Type 21 mechanical seal with carbon to silicon carbide sealing elements and EPDM elastomer.

7. Performance: See Table 11211SC-A. A factory performance test shall be run and certified for one of each size pump. Certified performance curves shall be submitted for engineer's review prior to shipping.

8. Base: A pump and motor base of structural steel with drip lip and drain, and grout holes with vents shall be supplied. Base shall be factory primed and painted.

9. Approved Pump Manufacturers: See table 11211SC-A below for pump manufacturers approved by the City.

10. Shaft Guard: Steel designed to meet OSHA requirements and removable for coupling maintenance.

11. Pump coupling: Faulk Steel-Flex sized for the application

C. Motors: Comply with Section 11210

1. General

a. Type: Open drip-proof, horizontal solid shaft squirrel cage induction
b. Standards: NEMA, IEEE, ANSI, AFBMA
c. Motors for variable speed pumps shall be invertor-rated.
d. Comply with Division 16.

2. Construction

a. Type: Open drip-proof, WP-1
b. Frame: Heavy fabricated steel or cast iron.

c. Space Heaters: Provide space heaters for motors to operate on 120v, single phase power. Leads shall be brought out to a terminal box enclosed in a NEMA 12 accessory box.
d. Shaft: High-grade machine steel or steel forging of size and design adequate to withstand all load stresses.
e. Stators: Random wound.
f. Rotor squirrel cage: Cast-aluminum or copper alloy box type construction with brazed end rings.
g. Bearings: Grease lubricated anti-friction type with an AFBMA average L-10 life of 100,000 hours.
h. Fasteners: All fittings, bolts, nuts and screws shall be plated to resist corrosion.
i. Terminal Box: NEMA-12 (oversized)
j. NEMA 4 Accessory Box
k. VPI 1000 Insulation System (impregnated)
l. Stainless Steel Hardware
m. Grounding Lug in terminal box
n. Motors shall be IEEE, NEMA MG1, Part 31 & 33, inverter duty rated for 10:1 turndown

3. Performance

a. Rating: 480 Volts, 3 phase, 60 hertz
b. Service Factor: 1.15 minimum
c. Load: Non-overloading over the entire operating range of the pump, exclusive of the service factor.
d. Horsepower: See Table 11211SC-A
e. Efficiency: Premium Efficiency see Table 11211SC-A
f. Factory Tests: Certified test results of test curves of motor performance from duplicate (similar) motors of recent manufacture for the tests listed below shall be furnished to the Engineer for review prior to shipment of motors.

1) No load current
2) Winding resistance
3) High potential dielectric tests
4) Bearing Inspection

g. Variable speed (VFD) units shall be tested with similar motor to be used on the project. The test shall be performed either at the pump manufacturer's facility under actual pumping conditions or the motor may be tested separately with the drive at a separate approved facility under simulated conditions. Factory tests shall include:

1) Performance curve data at various speeds specified.
2) Vibration testing over entire operating range.
3) Noise level testing over entire operating range.
4) Pump structural frequency analysis over entire operating range.
5) Electrical data (current load, horsepower) over entire operating range.

4. Manufacturers

a. U.S. Electrical Motors
b. Reliance Electric
c. General Electric
d. Or equal

2.03 ACCESSORIES

A. Pressure Gauges

1. Supply suction and discharge gauges for each pump, including pressure snubbers and isolation valves.

2. Gauges shall be in accordance with Section 15130 except:

a. Connection 1/2-inch NPT
b. Pressure range: (Discharge): 0 to 150 psi, (Suction): 0 to 50 feet, high service pumps.

2.04 SPARE PARTS

A. Provide the following spare parts for each model, size, and type of pump:

Quantity	Description
One (1)	Complete rotating assembly including shaft, impeller, bearings, rings, gaskets, etc., for complete replacement.

B. Pack spare parts in sealed, sturdy storage container, labeled with manufacturer's name and local representative's name, address, and date of delivery; and attach list of materials contained herein.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with Section 11210

B. Precautions shall be taken during installation of the pumps to ensure that the pumps remain free of contaminants and materials which are hazardous to the potable water system. If deemed necessary by the Engineer, the pumps shall be disinfected prior to initial start-up. After being connected to an existing potable water system, pump shall not be started until permission is given from the Owner or Engineer.

C. The pump equipment and base shall be level, prior to grouting. The Contractor shall use a machinist level (accurate to 0.0005” in a 10” span) tolerance to adjust shims, prior to securing and grouting the base. The final level shall be inspected and approved by the City’s inspector. The level shall be within 0.001” (one/thousandths of an inch).

3.02 INSPECTION AND TESTING

A. General: Comply with Section 11210.

1. A factory representative shall be provided for one (1) day, and shall have complete knowledge of proper operation and maintenance, to inspect the final installation and supervise the test run of the equipment. Test shall demonstrate that equipment performs without undue vibration or noise, overheating, or cavitation and performs as specified. For variable speed units, the pump shall be tested over its entire speed range.

2. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

B. Field Testing: (Demonstration Testing)

1. Upon completion of all the mechanical work, the Contractor shall conduct testing to Demonstrate that the equipment performs in accordance with all specifications and at the conditions specified in Table 11211SC-A.

2. In the event that the equipment does not meet the specifications, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which he deems necessary (with the approval of the Engineer), and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

3. The Owner will pay the salaries of his personnel selected by the Owner for operation of the equipment. Payment of all other salaries, public utility services, and operating expenses shall be borne by the Contractor for the test period and any additional test period required.

4. The Contractor shall submit a certificate from the equipment manufacturer stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit.

(Remainder of This Page Left Blank Intentionally.)

TABLE 11211SC-A

PUMPING UNIT DESIGN REQUIREMENTS

	High Service Pumps 1-3		
PUMP PERFORMANCE DATA			
Pump Design Speed (rpm)	1,800		
Point #1 - Design Flow (gpm)	1,680		
- TDH (feet)	136		
- Min. Pump Efficiency (%)	81.0		
Minimum Efficiency at Best Efficiency Point	82.5		
Min. Pump Suction Connection Size (in.)	8		
Min. Pump Discharge Connection Size (in.)	6		
Maximum Motor (hp) (inverter-rated)	75		
Minimum Motor Efficiency (%)	95		
Maximum Motor Sound Pressure Level @ 5 feet (dba)	70		
Control	Variable-Speed		
Design Pump,	Peerless-6AE14. Patterson-6MI-C Aurora-6X8X15 Fairbanks Morse-6X8X15		
Run-out Condition (Max. _____ gpm @ _____ TDH)	Max flow at 100 FT.		
Maximum Net Positive Suction Head Required at Point # 1 (feet)	16.0		

NOTES:

1. All three (3) pumps shall be of the same manufacturer, model, and size.
2. Pumps shall not overload motor horsepower at any point on the pump curve.
3. Tolerances for pump curve fit: flow shall be 0% and head shall be 1.0%.
4. Tolerance for pump efficiency shall be 1.0%

END OF SECTION

SECTION 11346

CHEMICAL FEED EQUIPMENT

PART 1 - GENERAL:

1.01 DESCRIPTION:

A. Furnish and install two (2) Chemical Feed (Metering Pump) Equipment Skids at the location shown on the drawing and as specified herein. The Chemical Feed equipment shall be pre-assembled skids with mechanically actuated diaphragm positive displacement, motor driven, metering type pumps and accessories for feeding to the injection points. The chemical feed system shall include metering pumps, motors, pump controls and all piping and components required for the complete operating installation in accordance to contract documents.

1.02 SUBMITTALS:

A. Manufacturer's literature, illustrations, specifications and engineering data including: dimensions, materials, size, weight, performance data, required net inlet pressure, flow rate, motor horsepower and speed for review.

1.03 QUALITY ASSURANCE:

A. All work under this specification shall be the responsibility of the Equipment Supplier and Contractor.

B. The Chemical Feed Equipment manufacturer shall be a company specializing in the manufacture, assembly and field performance of the chemical feed metering pump skids with a minimum of five years experience. The Chemical Feed Equipment manufacturer is responsible for meeting the requirements of this specification and related work specified elsewhere. In addition, they shall coordinate operation of their equipment with the Contractor including but not limited to:

1. Providing any and all information on the performance/characteristics of their equipment.

2. Providing wiring and installation diagrams, operational and shutdown interlocks.

3. Providing shop drawings, parts lists, materials of construction, tolerance, coatings, and certification of compliance with generally accepted standards.

PART 2 - CHEMICAL METERING PUMPS:

2.01 OVERVIEW:

A. Sodium Hypochlorite or Chlorine Solution (CS) Pumps shall be GRUNDFOS Model DME 48-3 AR-PV/V/C-F-21SSB capable of 12.68GPH @ 38 PSIG.

B. Aqueous Ammonia (AA) Solution Pumps shall be GRUNDFOS DME 8-10 AR-PV/T/T-21RRB capable of 1.98GPH @ 145 PSIG.

C. Chemical metering pumps shall be driven by a microprocessor controlled brushless DC motor with a minimum of 800:1 turndown ratio. The DC motor is to be direct coupled to a

planetary gear assembly which drives the diaphragm assembly. The diaphragm is to be Teflon-faced composite construction. The drive assembly shall be a maintenance free design.

D. The pump shall operate at 100% stroke length throughout the pumps entire capacity range. Stroke length adjustment shall not be necessary to achieve 800:1 turndown**.**

2.02 ENCLOSURE:

A. Drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure. The enclosure shall include integral body fins for heat dissipation and strength.

B. The pump design shall include provisions for optional positioning of the control interface/display, for side and front mounting.

C. Pump enclosure rating shall be to IP65 standards.

2.03 DRIVE:

A. The pump's stroke length will always be 100%. No adjustment to the stroke length, to regulate flow, or for other reasons, is acceptable.

B. An integral variable speed brushless DC motor/gear arrangement - shall be used to ensure the pump discharge phase extends through out the full period between suction intervals.

C. The motor shall be integral, supplied with power cord and plug.

D. The drive mechanism shall not require regular field service or external lubrication**.** Gear and motor components shall be permanently lubricated. Oiler lubrication, oil bath or oil mist systems are not acceptable.

2.04 INTERFACE:

A. User interface/display shall be backlit LCD with selectable positioning for either side or front mounting.

B. The interface shall provide a selection of metered output to be displayed in Gal/hr, L/hr or ml/hr. Pumps displaying percent (%) of output only will not be accepted.

C. The interface shall include a lock function to protect against unauthorized changes.

D. A built in counter shall be included to provide a running total of, accumulated strokes, cumulative hours of operation and dosing flow.

E. A priming button shall be provided on the interface. The priming button shall initiate a time selectable prime cycle operating at full capacity without need of attenuating the pumps output set point.

F. A system of red and green LED lights shall indicate pump status and alarm conditions.

2.05 LIQUID END:

A. The process diaphragm shall be Teflon-faced, fabric reinforced and bonded to pre-formed elastomeric support with metal insert.

B. Suction and discharge valves are to be cartridge design. Direction of flow shall be clearly marked on each check valve to ensure correct installation.

C. Head design shall incorporate integral priming valve.

D. A back-plate with separation chamber shall have a safety lip seal and drain hole. The pump shall be designed to accommodate an optional leak detection device.

E. Pump head shall include NPT female or male threaded connectors for suction and discharge connections.

2.06 OPERATION:

A. Repeatable metering accuracy shall be ±1% at constant hydraulic conditions throughout the entire output range.

B. The pump shall be equipped with an anti-cavitation function for use with viscous liquids or those with off gassing tendencies. The anti-cavitation function shall be a configurable operating parameter that permits the suction speed to be reduced to 25%, 50% or 75% of maximum to ensure optimal priming and pumping reliability.

C. The pump shall be equipped with a calibration function which when initiated operates the pump for a set number of strokes and displays the anticipated pumped volume. The calibration process allows adjustment of the pump to set the calibration relative to the drawdown volume.

D. The pump shall be equipped with provisions for selectable mode NO/NC external pump enable/disable interface.

E. A configurable maximum capacity limit shall be included in the interface menu. The limit value is to be specified as (gal, ml or liters) per hr.

F. The pump shall be equipped with input connections for dual level control and alarm outputs for low-level and empty tank warnings.

2.07 CONTROL:

A. The pump shall come equipped with 5 menu selectable control modes; Manual, analog, pulse, timer or batch. Optionally, the pump shall also be Profibus compatible.

1. Manual Control:

- Output of pump is displayed in gal, mls or liters per hour. Pump output adjustment is performed with increase/decrease buttons on the interface. Adjustment knobs are not acceptable.

- Pumping rate changes are to be achieved through precise speed control with fixed full stroke length.

- Pump output is to comply with prescribed menu maximum capacity value.

2. Automatic Control:

- Analog: Pump shall include direct interface provisions for analog control. Both direct and reverse acting 0/4-20ma input configurations are to be acceptable inputs. The menu configuration shall permit pump maximum output scaling. The pump shall include a local alarm for loss of input signal.

- Pulse: The pump shall include direct interface provisions for pulse output devices. In pulse control mode, the pump shall be configured to deliver a volume of product per incoming pulse. The pump speed shall attenuate the delivery rate based on the frequency of pulses generated by the external device.

- Batch: In batch mode the pump shall respond to deliver a menu configurable quantity of liquid after receiving a remotely provided contact input.

- Timer: The pump shall be equipped with a ten-day internal timer. The configuration menu shall permit the user to prescribe timed sequence start point and the time between each successive timed delivery cycle.

- Optional Control via Profibus (Fieldbus) connection

PART 3 - PACKAGED SKID SYSTEM:

3.01 CONSTRUCTION:

A. Each chemical feed system is to be completely assembled, calibrated, tested, and delivered to job site on a single skid. Components to be mounted on the skid as indicated on approved drawings to include but are not limited to dosing pumps, calibration columns, valves, piping accessories (pulsation dampeners, back pressure valves, pressure relief valves, Y-strainers and pressure gauges etc.), and primary wiring on the skid.

B. Welded PVC Skid Frame Construction: Welded PVC skid frames shall be fabricated from PVC sheet with a minimum trade thickness of 1/2-inch. The design of the skid shall include gussets and supports as required for all components and shall be self-supporting. All components of the chemical metering system shall be contained within the skid. The skids shall be fabricated using continuous welding technology; bolted construction is not acceptable.

C. Containment Basin: The metering pump skids shall have a 6” deep spill containment integral to the skid. Upon request this containment basin shall have provisions for local and remote level alarms. All pumps shall be raised above the conceived maximum chemical level in the containment basin so that the pumps will not come in contact with the chemical in the basin.

D. Number of Pumps per Skid: Two pumps no exceptions. Each chemical metering pump shall be completely assembled, mounted, calibrated, tested, and delivered to the job site on a single skid.

3.02 PIPING AND FITTINGS:

A. The Metering Pump Skids shall be supplied with 0.50-Inch diameter schedule 80 PVC piping and fittings on the common suction header. All discharge piping is to be 0.50-Inch diameter schedule 80 CPVC. Special machined fittings/blocks that are not of standard manufacture will not be accepted.

B. The Skid Manufacturer shall make liberal use of unions in order to facilitate pump removal without disturbing the suction or discharge piping.

C. The metering pumps shall employ unions on the suction and discharge of the pump to allow replacement or maintenance removal of the pump without disturbing the suction or discharge piping.

D. All valves on the metering pump skid shall HAYWARD PVC True-Union Ball Valves.

E. Pipe and Accessory Support:

1. All piping accessories shall be securely fastened to the frame or supported with stand-offs. The use of steel bands or strapping shall not be acceptable.

2. Metallic supports and hardware shall be 316 Stainless Steel.

3. Piping straps shall be removable and reusable to allow for service of the system.

3.03 PUMP ACCESSORIES:

A. Each chemical metering pump shall include the accessories described herein and shown on the Drawings. These components shall be supplied by the Skid Manufacturer and mounted accordingly on each skid. All components of the skid-mounted system (pumps, piping and controls) shall be factory pressure tested with water prior to shipment.

1. Y-strainers:

- Manufacturer: HAYWARD
- Model Number: YS100050SU
- Wetted Parts: PVC / VITON / PTFE
- Connections: ½" Socket Weld Union

2. Calibration Cylinders:

- Manufacturer: ACCUDRAW
- Wetted Parts: PVC and Acrylic
- Graduations: The scale shall give direct readings in gallons per hour without the need for calculations.
- Top of Cylinder: The top of the chamber shall have a threaded fitting to allow for piping to a common overflow pipe. The CONTRACTOR shall furnish piping and fitting to convey the overflow piping to the sump.
- Isolation Valves: Furnish one isolation ball valve for each calibration cylinder on the bottom of the cylinder to isolate the cylinder from the suction piping.

3. Pressure Relief Valves:

- Manufacturer: GRIFFCO VALVE, INC.
- Model Number: M-Series
- Valve Top: PVC
- Diaphragm: PTFE
- Pressure Adjustment Range: 0 to 150 psig.
- Pressure Relief Return Piping: Output of the pressure relief valves shall return pump suction header using clear schedule 80 PVC piping for relief flow indication.

4. Back Pressure Valves:

- Manufacturer: GRIFFCO VALVE, INC.
- Model Number: M-Series
- Valve Top: PVC
- Diaphragm: PTFE
- Pressure Adjustment Range: 0 to 150 psig.

5. Pressure Gauges:

- The transfer system shall incorporate a 2-1/2”inch liquid filled pressure gauge on the discharge of the pump. Each gauge shall be protected by a glycerin filled gauge protector. The discharge gauge shall be rated 0- 100 psig. The casings of the gauge shall be stainless steel and accuracy shall be 2% or better.

5. Diaphragm Seals:

- Gauge assemblies shall incorporate a ½” diaphragm seal on the liquid side of the pressure gauge.
- Manufacturer: PLAST-O-MATIC
- Model Number: GGMT1-PV
- Wetted Parts: PVC
- Diaphragm Material: PTFE

3.04 MANUFACTURER’S FIELD SERVICES:

The Manufacturers Field Services to assist the Contractor including testing and start-up shall be provided separately form services to the Owner. The field services of a qualified manufacturer's technical representative shall be provided for Owners Staff as follows. Training with Owners staff shall be coordinated by the Contractor and scheduled at least 10 days in advance.

Service	Number of Trips	Hours per Trip
Supervise functional testing and adjustments of the equipment. Provide Training to Owners staff. Provide Start-up and Testing Services with Owners Staff.	1	6

3.05 FIELD TESTING:

The Contractor shall test the operation and performance of all equipment, pumps, valves piping, and controls as recommended by the equipment supplier. All field testing shall be complete before system start-up and demonstration to Owner.

- END OF SECTION -

SECTION 13421

VENTURI FLOW METER

PART 1 - GENERAL

1.01 Products: The flow meter shall be a short form Venturi design utilizing pure static pressure sensing taps in the inlet and throat sections and shall produce a differential pressure, which shall be measured and transmitted by the specified differential pressure transmitter.

1.02 Performance**:** The Venturi flowmeter shall have an accuracy of +/-0.5% of actual flow above a pipe Reynolds number of 75,000 with a discharge coefficient of 0.9900 and a permanent pressure loss not exceeding 10% of the differential.

1.03 Tube Design**:** The Venturi meter shall have a cylindrical inlet section of the same I. D. as the inlet piping and shall contain two high pressure taps and a single vent and drain tap. The cylindrical throat section shall contain two low-pressure taps. The length of the cylindrical throat section shall be equal to one-half its diameter. The converging section shall be comprised of a single angle of 30 degrees. Converging sections using a radius or multiple inlet angles will not be acceptable. The recovery section shall be comprised of a single angle of 10 degrees and shall be truncated at approximately 90 % of the downstream pipe I.D. The Venturi shall be provided with AWWA type 125/150 pound flanged ends unless otherwise specified.

1.04 Sizing**:** The venturi meter design shall be based on the following criteria:

a. Line Size: 24.0” to be installed in DI pipe
b. Ends: 125/150# ANSI Design
c. Flow Rates:
    (1) Minimum flow rate is 1250 GPM
    (2) Maximum flow rate is 5300 GPM
d. Differential:
    (1) Differential at the minimum flow rate shall be 5.23” w.c..
    (2) Differential at the maximum flow rate shall be 94.11” w.c..

1.05 Materials**:** The Venturi meter body shall be cast iron per ASTM A-126, Gr. B. and the foundry shall be located in North America. The throat section and high-pressure tap bushing shall be 304 stainless steel. The interior and exterior of the cast iron surfaces shall be coated with NSF-61 2-part epoxy suitable for potable water contact.

1.06 Testing: Each Venturi meter shall be flow calibrated by an independent flow lab and provided with certified copies of the test results to substantiate the flow meter’s accuracy, discharge coefficient and permanent pressure loss. In lieu of lab flow calibration, the manufacturer may provide prior independent lab test data substantiating the flow meter’s accuracy, Reynolds number performance, installation effects, discharge coefficient, and head loss. Prior test data shall cover at least 36 lab calibrations in sizes from 2.0 to 48.0".

1.07 Quality Assurance**:** The venturi meter supplier shall provide written certification that the cast iron portion of the meter is of North American origin in order to insure that it meets applicable ASTM code requirements. In addition, in order to insure a high level of quality control in the design and manufacturing of the venturi meter, the venturi meter manufacturer must be ISO

9001 certified. A copy of the current certification shall be included in the submittal for approval documentation. If any parts of the meter contain a welded joint, the manufacturer shall hold a valid and current ASME S, U & R code stamp to insure proper weld design and quality.

1.08 Warranty**:** The manufacturer shall provide a 25-year warranty against defects in workmanship and materials.

1.09 Supplier Experience**:** The manufacturer of the Venturi meter shall have a minimum of 20 years experience in providing differential type flow meters of the type and design specified.

1.10 Supplier**:** The Venturi meter shall be a Model HVT-CI as manufactured by Primary Flow Signal, Inc., Cranston, RI USA or an engineer approved equal meeting all the above requirements and specifications.

2.02 SIGNAL CONVERTER

A. Provide converter/transmitter for each flow meter.

1. Design: Solid state from same manufacturer as flowmeter. Incorporate automatic zero stability without flow interruption.

2. Mounting: Integral mounted or wall mounted within 30 feet of the flow meter.

3. Enclosure: Splash and dust proof NEMA Type 6/IP67, cast aluminum or stainless steel construction.

4. Electrical: Provide power and shielded signal wires between the flowmeter and the transmitter in separate conduit resistant of submergence in water.

5. Electronic Converter: Integral or remote transmitter electronics based on the principle of pulsed DC coil excitation to eliminate the need to periodically reset zero signal at zero flow.

6. Power Requirements: 115V AC, 60 Hz.

7. Power Consumption: 10 watts maximum.

8. Flow Indicator: Flush mounted in the transmitter enclosure. Display flow conditions in GPM with an accuracy of ±2.0 percent of span.

9. Outputs: Two signals linear and directly proportional to flow.

    1. 4-20 mA DC isolated into 0 - 600 ohms.
    2. 0-10 kHz scaled pulse.

10. Low Flow Cutoff Limit: Drive the output to zero when the measured flow rate is 0-10 percent (adjustable) of full scale and when fully developed flow no longer exists. Provide an isolated contact output signal rated 2A, 24V DC.

11. Positive Zero Output: Provide feature which drives the output to zero flow (4 ma) based on external contact closure.

12. Output Signal Ripple Voltage: Maximum peak to peak, less than 0.2 percent.

13. High Impedance Sensing: Provide sensing amplifiers with high impedance to minimize effects of deposit build-up on the electrodes.

14. Interchangeable Electronics: Provide converter/transmitter that is interchangeable with all flowmeter sizes of manufacturer's same model.

15. Operating Temperature: 14 to 170°F (-10 to 77°C).

16. Humidity: 10 to 90 percent non-condensing.

2.03 SOURCE QUALITY CONTROL: Hydraulically calibrate flowmeters against a master meter traceable to the National Bureau of Standards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount the flowmeter in the process pipe at a location to ensure a full pipe under both flow and no-flow conditions. Locate the flowmeter in a straight run of pipe at least five pipe diameters upstream and two diameters downstream of any turbulence producing devices or fittings and as shown on the drawings.

B. Ground flowmeters using grounding probes or 0.125 inch thick grounding rings placed between the meter and mating flanges at both ends of the meter, or as recommended by the manufacturer of the meter. Provide an earth ground. Do not use process piping for grounding.

C. Supply the power for the flowmeter and the transmitter from the same power source and electrical phase. Provide separate conduits for signal and power wiring to connect the meter to the signal converter/transmitter.

END OF SECTION

SECTION 13442

TOTAL CHLORINE RESIDUAL/pH ANALYZER

PART 1 - GENERAL

1.01 SUMMARY

A. This section describes the equipment to be provided by the City and installed by the Contractor. The Contractor shall provide piping, valves, supports and other associated materials to complete the installation as shown on the plans.

1.02 PERFORMANCE REQUIREMENTS

A. Equipment shall be capable of meeting the following performance requirements when installed in accordance with the manufacturer's recommendations. The measured signal shall have:

Measurement of Total Chlorine:

1. Accuracy: greater of 0-0.20 mg/l or +/- 6%
2. Stability: +/- 5% F.S. under typ. Cond. For 1 month
3. Response: 90% change < 20 seconds

Measurement of pH:

1. Range: ph 4 to 10
3. Sensitivity: 0.01 pH

PART 2 - PRODUCTS

2.01 CHLORINE RESIDUAL ANALYZER (Provided by City)

A. The chlorine residual/pH analyzer system shall continuously measure and indicate the total chlorine residual concentration of the process liquid. The analyzer system shall consist of an amperometric type sensor, indicating transmitter, junction box, and interconnecting cabling between the sensor, junction box, and transmitter. The chlorine residual/pH analyzer system shall be Siemens, Wallace & Tiernan, model Depolox 3 Plus, to match existing equipment.

B. The sensor shall be of the amperometric type. Sensor body shall be PVC and suitable for immersion in the process. The sensor shall contain a field replaceable chlorine permeable membrane held in place with a threaded retainer ring or screw cap.

C. A weatherproof NEMA 4 junction box shall be provided. The junction box shall have a quick-disconnect pin receptacle for the sensor interconnecting cable. An

additional 5 feet of interconnecting cable shall be provide for connection to the transmitter.

D. Output Signal: 4-20 mA max. 1000 ohm load, electrically isolated. (1) disinfection sensor (1) pH sensor. External alarms shall be provided separately for disinfection and pH. Digital communication shall be per RS485 connection.

PART 3 - EXECUTION

3.01 INSTALLATION (By Contractor)

A. The City's Water operations Staff will supervise and inspect the equipment installation to insure that it is installed in accordance with the manufacturer's recommendations.

B. Install analyzers as shown on the mechanical, electrical and instrumentation drawings.

C. The analyzer enclosure shall be located to provide sufficient space around and on top of the enclosure to facilitate necessary maintenance. It shall be the Contractor's responsibility to provide and install necessary valves, piping and any other accessories required to withdraw water sample from the main stream and deliver it to the analyzer; and to drain the analyzed sample water to the plant drain.

D. Provide all necessary corrosive resistant 18-8 grade stainless steel mounting hardware and special tools for installation.

E. Use manufacturer's recommended cable between sensor and analyzer transmitter. Provide all wiring, including complete electrical & instrumentation connections to system.

END OF SECTION

SECTION 15108

HIGH DENSITY POLYETHYLENE PIPE (HDPE)

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work under this Section consists of furnishing all labor, equipment and materials necessary for the construction OF HDPE water main, force main or reclaimed water main as shown on the Drawings and specified herein.

1.02 STANDARDS

A. ASTM 3350-05: HDPE Pipe Standards

B. ANSI/AWWA C901-2005: Pipe and tubing ½" through 3" for water services

C. ANSI/AWWA C906-2006: Pipe 4" through 63" for water distribution

1.03 SUBMITTALS

A. The Contractor shall submit Shop Drawings including material specification, color code, pressure class, Working Drawings and samples in accordance with the General Requirements and Division 1. Submittals shall include details of transition couplings at connections to pipelines of other materials.

1.04 QUALITY ASSURANCE

A. Standards: All pipe, fittings and other appurtenances shall conform to the latest AWWA standards and applicable Manufacturer's standards for HDPE pipe.

B. All materials shall be subjected to visual inspection following delivery and prior to installation. Materials that do not conform to the Specifications will be rejected and must be removed immediately from the job site by the Contractor.

1.05 DELIVERY, STORAGE AND HANDLING

A. Pipe materials damaged during transport or delivery shall be rejected and removed from the site. On site pipe storage shall meet AWWA standards and the pipe manufacturer's storage requirements or recommendations.

D. The Contractor shall properly store and protect the pipe materials until the pipe is installed. Pipe damaged in any way during storage shall be removed from the project. There will be no payment for damaged materials.

E. The Contractor shall store fittings in their original cartons. All materials that are delivered in protective packaging shall remain packaged until needed for installation.

F. Material handling shall comply with the pipe manufacturer's requirements or recommendations.

PART 2 - PRODUCTS

2.01 GENERAL

A. HDPE shall conform to ANSI and AWWA standards as referenced and specified in this section. Small diameter piping shall be compatible with copper fittings. Larger diameter piping shall be compatible with ductile iron pipe sizes (DIPS). All HDPE piping shall be color coded. All HDPE shall be traceable with tracer wire as required.

2.02 PIPE

A. Potable Water and Reclaimed Water Service Lines: HDPE AWWA C901 pipe (1/2" through 3") shall be PE 3408/PE 4710, SODR 9.0, 200 psi pressure class with 10 gauge tracer wire, taped to the pipe exterior.

B. Potable Water and Reclaimed Water Mains: HDPE AWWA C906 pipe (4" through 60") shall be PE 3408, SDR 11.0, 160 psi pressure class in accordance with the referenced standards.

C. Wastewater Force Mains: HDPE AWWA C906 pipe (4" through 60") shall be PE 3408, SDR 17.0, 100 psi pressure class in accordance with the referenced standards.

2.03 FITTINGS

A. Large diameter HDPE pipe fittings in sizes from 4" through 60" shall be joined to pipe material by heat fusion method when required or shown on the drawings. Generally, fittings in larger diameters (4" through 54") shall be ductile iron. HDPE pipe shall be welded to a transition coupling to allow connection to DIP fittings or connection to other pipe materials.

PART 3 - EXECUTION

3.01 GENERAL

A. Install two (2) 10 gauge copper wire with plastic coating for pipe tracing/detection. Tracer wire, if broken during pull back, shall be replaced by installation of a new wire installed by directional bore method.

B. HDPE ends shall be welded to a transition fitting for connection to ductile iron pipe fitting with mechanical restraint. Restrained length from transition connection shall be 34 feet minimum, including a least two pipe joints.

C. Color Code shall be as follows: Potable Water = Blue, Reclaimed Water = Purple, Wastewater Force Main = Green.

3.02 INSTALLATION

A. Erosion and sedimentation control measures and on-site containers shall be installed to prevent drilling mud from spilling out of entry and/or exit pits. Drilling mud will be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.

B. No other chemicals or polymer surfactant shall be added to the drilling mud without written consent of the Engineer. Allowed chemicals used shall be environmentally safe or biodegradable.

C. The pipe entry area shall be graded to provide support for the pipe to allow free movement into the bore hole. The pipe shall be guided in the bore hole to avoid deformation of, or damage to, the pipe.

D. As-built variance from the designed bore path shall not exceed ±1 foot in the vertical plane and 2 feet in the horizontal plane. Contractor shall submit any proposed deviations from the design bore path with shop drawings. Pipe that does not meet the aforementioned tolerances shall be a considered defective. The Owner/Engineer may require such defective pipe to be replaced by the Contractor with non-defective pipe at no additional cost to the Owner.

3.03 DISINFECTION AND TESTING

A. Perform disinfection and pressure testing of HDPE pipe as per City of Titusville Utility Standards and AWWA C651.

END OF SECTION

SECTION 15117

WATER REGULATING VALVES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Scope of Work: Furnish and install water regulating valves with Electronic Controller of the type, size, and capacity shown on the Drawings and as specified herein (see Table 15117-A).

B. General Design: Water regulating valves shall consist of hydraulically operated, diaphragm actuated globe or angle pattern valves.

1.02 QUALITY ASSURANCE

A. Qualifications: See Section 15110.

B. Standards: See Section 15110.

C. Warranty: See Section 15110.

D. Valve Manufacturers

1. OCV Control Valves LLC
2. Bermad
3. Or City approved equal

1.03 SUBMITTALS: Submittals shall be in accordance with Section 15110.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING: Product delivery, storage and handling shall be in accordance with manufacturers recommendations.

1.05 SPECIAL TOOLS AND SPARE PARTS: Provide one (1) spare override solenoid valve for each control valve requiring an override solenoid valve.

PART 2 - PRODUCTS

2.01 GENERAL:

2.02 MATERIALS: (Basic Valve)

A. Main Valve Body and Cover: Ductile Iron ASTM A-536 Grade 65-45-12

B. Main Valve Trim

1. Brass: QQ-B-626
2. Bronze: ASTM B-61
3. 18-8 Grade Stainless Steel

C. Pilot Controls: Bronze ASTM B-61

D. Pilot Control Trim: 18-8 Grade Stainless Steel

E. Disc: Resilient Synthetic Rubber

F. Diaphragm: Nylon Fabric bonded with synthetic rubber

2.03 DESIGN

A. The main valve shall be hydraulically operated, diaphragm actuated full ported valve designed with minimum pressure loss wide open. Main valve seat area shall be equal to or greater than area of inlet/outlet connection.

B. Valve disc shall have a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a water tight seal against a single removable seat insert.

C. Diaphragm assembly valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat.

D. Diaphragm shall not be used as a seating surface and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure.

E. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing the valve from the pipeline.

F. Service: See Table 15117-A

G. Connection

1. Pattern: 125 lb ANSI B16.1
2. Size: See Table 15117-A

H. Pilot Control Piping: Stainless steel tubing.

1. Potable Water Service: 1/4-inch diameter tubing
2. Reclaimed Water Service: 1/2-inch diameter tubing

I. Pilot Control Valve Body Castings: Minimum 1/4-inch wall forged bronze ASTM B-61 per ASME Boiler codes.

J. Coatings: FDA fusion bonded epoxy coating on exterior and interior of main valve body.

K. Features: (also see Table 15117-A)

1. Adjustable opening and closing speeds.

2. Pilot piping system shut off cocks.

3. Valve stem limit switch position indicator to indicate full open and closed position; provide interface with system telemetry.

4. Atmospheric drain when required by valve function.

2.04 VALVE FUNCTION (TYPE) AND PILOT CONTROL; See Table 15117-A

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with Section 15110, the manufacturer's recommendations and as indicated on the Drawings.

B. Check-out and Demonstration testing shall be provided in accordance with Division 1.

(Remainder of This Page Left Blank Intentionally.)

TABLE 15117-A

WATER REGULATING VALVES

DESCRIPTION	CONTROL VALVE			
1. Mark/Number	CV-6	CV-7		
2. Type of Valve OCV Model #	Flow Metering & Control Valve with Back Pressure Overide Control with Electronic Controller Model 22VMU-BP	Flow Metering & Control Valve with Back Pressure Overide Control with Electronic Controller Model 22VMU-BP		
3. Size (inches)	8"	12"		
4. Service Liquid a. Type b. Temperature (□F)	 Potable Water 180□F Max	 Potable Water 180□F Max		
5. Pressure (psig) a. Working Range b. Initial Setting (Min.) Initial Setting (Max.)	 30-70 Per PLC Per PLC	 20-50 Per PLC Per PLC		
6. Valve Pattern	Globe	Globe		
7. Valve Position a. Normally b. Action c. Other	 Closed Open/Close Modulate as needed to control flow or sustain pressure	 Closed Open/Close Modulate as needed to control flow or sustain pressure		

TABLE 15117-A

WATER REGULATING VALVES

DESCRIPTION	CONTROL VALVE			
8. Actuator	PLC/SSV operated hydraulic Diaphragm	PLC/SSV operated hydraulic Diaphragm		
a. Override to close by	Solenoid 24 VDC	Solenoid 24 VDC		
1.	1. See Electronic Controller/PLC	1. See Electronic Controller/PLC		
2.	2.	2.		
3.	3.	3.		
9. Remarks	Controls filling of GST controlled by PLC,	Controls filling of GST, controlled by PLC,		
a. Flow Range (gpm)	1000-2000	1500-4000		
b. Back Pressure (psi)	N/A	N/A		
c. Other	Loss of power closes valve	Loss of power closes valve		

END OF SECTION

SECTION 16050

ELECTRICAL - GENERAL PROVISIONS

PART 1 - GENERAL

1.01DESCRIPTION

A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required for a complete electrical system as hereinafter specified and shown on the Drawings, whether or not specifically shown or called for.

2. The work, apparatus and materials which shall be furnished under these Specifications and accompanying Drawings shall include all items listed hereinafter an/or shown on the Drawings. All materials necessary for the complete installation shall be furnished and installed by the Contractor to provide complete power, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein whether or not specifically shown or called for. Certain equipment will be furnished as specified in other Section of this specification that will require conduit and wire to complete the installation as required.

3. The Contractor shall furnish and install the necessary cables, transformers, motor control centers, protective devices (surge protection), conductors, exterior electrical system, etc., to serve motor loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified hereinafter.

4. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

5. Provide permitting and acceptance testing.

6. Make all field connections to process instrument panels and other control panels furnished under other Divisions of these Specifications.

7. For process instrumentation furnish and install all conduit, wire and interconnections between primary elements, transmitters, local indicators and receivers.

8. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material, equipment, appliances and all work, which may be reasonably implied as being incidental to the work of this Section, shall be furnished at no extra cost.

9. Each bidder or his authorized representatives shall, before preparing a bid, visit all areas of the existing building and/or proposed site in which work will take place and be performed to inspect carefully the present installation and conditions. The submission of the bid by this bidder shall be considered evidence that the bidder has visited the project and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing his work.

10. All necessary temporary power requirements are the responsibility of the Contractor and shall be furnished at to extra cost to the Owner

11. All necessary temporary power, control and instrumentation requirements are the responsibility of the Contractor and shall be furnished at no extra cost to the Owner. Power and controls shall be furnished to all existing equipment at all times.

B. Codes, Inspections and Fees:

1. All material and installation shall be in accordance with the latest edition of the National Electrical Code and all applicable national, local and state codes.

2. Pay all fees required for permits, inspections, and connections.

C. Tests:

1. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

D. Interpretation of Drawings:

1. The Drawings are not intended to show exact location of conduit runs.

2. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.

3. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

4. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

5. The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, and architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Owner's authorized representative is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

6. Verify with the Engineer exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

7. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and, in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

8. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

9. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.

10. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchases of the equipment.

11. All connections to equipment shall be made as shown, specified, required, and directed and in accordance with the approved shop drawings, regardless of the number of conductors shown on the Electrical Drawings.

E. Size of Equipment:

1. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

2. The equipment shall be kept upright at all times. When equipment has to be tilted for each of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

F. Component Interconnections:

1. Component equipment furnished under this Specification will not be furnished as integrated systems.

2. Analyze all systems components and their shop drawings; identify all terminals and prepare drawings or wiring tables necessary for component interconnection.

G. Record Drawings:

1. As the work progresses, legibly record all field changes on a set of project Contract Drawings.

1.02SUBMITTALS

A. Material and Shop Drawings:

1. Shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the Engineer.

2. Shop drawings shall be submitted for the following equipment:

a. Wire and Cable

b. Supporting Devices

c. Variable Frequency Drives

d. Conduit

e. Receptacles

f. Boxes and Fittings

4. Prior to submittal by the Contractor, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.

5. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings, which may not be indicated on the shop drawings, is included under the work of this Section.

6. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.

7. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

B. Manufacturer's Services

1. Provide manufacturer's services for testing and start-up of the following equipment:

a. Variable Frequency Drives

2. Provide manufacturer's of the above listed equipment shall provide an experienced Field Service Engineer to accomplish the following tasks:

   a. The equipment shall be visually inspected upon completion of installation and prior to energizing to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "as-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity.

   b. The Field Service Engineers shall provide engineering support during the energizing and check out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the manufacturer's performance specifications.

   c. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.

   d. One (1) 4-hour training sessions on operation, and one (1) 4-hour training sessions on maintenance and trouble-shooting procedures shall be provided for the Owner's maintenance personnel. All training shall be conducted at a facility provided by the Owner. The maintenance and trouble-shooting sessions shall be conducted with record "as-built" electrical drawings sufficient for a class of eight personnel.

   e. A final report shall be written and submitted to the Contractor within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action.

PART 2 - PRODUCTS

2.01MATERIALS AND EQUIPMENT

A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Engineer.

B. Materials and equipment used shall be Underwriters Laboratories, Inc., listed.

C. Electrical equipment shall, at all times during construction, be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be

stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, the Contractor at his own cost and expense shall repair such damage. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

PART 3 - EXECUTION

3.01INSTALLATION

A. Provide and place all sleeves for conduits penetrating floors, walls, partition, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. All cutting and patching shall be done in a thoroughly workmanlike manner.

3.02INSPECTION AND TESTING

A. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

END OF SECTION

SECTION 16110

RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.01DESCRIPTION

A. Scope of Work:

1. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

B. The complete raceway system above grade shall be rigid aluminum conduit and fittings and raceway systems above and below grade for shielded instrumentation wiring. The complete raceway system below grade shall be Schedule 40 PVC non-metallic conduit and fittings, except for raceway systems for shielded instrumentation wiring. Raceway systems for process shielded instrumentation wiring and motor feeders between variable frequency drives and the motor terminal housings shall be rigid aluminum. Raceway systems for interior administration area in air-conditioning plenums shall be EMT steel conduit

1.02QUALITY ASSURANCE

A. Qualifications:

1. The equipment shall be products of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

B. Standards:

1. Underwriters Laboratories, Inc. (U.L.).

2. American Society for Testing and Materials, (ASTM).

3. Federal Specifications.

C. Manufacturers:

1. Non-Metallic Raceways.

a. Carlon.

b. Triangle Pipe and Tube Co.

c. Phillips Petroleum Co.

d. Indian Head Company.

e. Or equal.

2. Metallic Raceways:

a. Youngstown Sheet and Tube Co.

b. Allied Tube and Conduit Corp.

c. Wheeling-Pittsburg Steel Corp.

d. Or equal.

1.03SUBMITTALS

A. Material and Shop Drawings:

1. Copies of all materials required to establish compliance with these specifications shall be submitted in accordance with the provisions of the General Conditions. Submittals shall include at least the following:

a. Certified shop drawings with performance data and physical characteristics.

b. Descriptive literature, bulletins, and/or catalogs of each item of equipment.

c. All information required by Section 01340.

d. A complete total bill of materials for all equipment.

2. In the event that it is impossible to conform with certain details of the specifications, describe completely all non-conforming aspects of the Shop Drawing transmittal.

PART 2 - PRODUCTS

2.01GENERAL

A. The specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in these specifications, or shown on the Drawings shall be furnished and installed.

B. The material covered by these specifications is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

2.02MATERIALS AND EQUIPMENT

A. Metallic Conduit:

1. ALUM conduit shall contain less than 0.1 percent copper and conform to Federal Specification WW-C-540C.

B. Non-Metallic Conduit and Fittings:

1. PVC conduit shall be schedule 40 or 80 composed of High Impact PVC (polyvinyl) chloride (C-200 Compound), and shall conform to industry standards, and be UL listed in accordance with Article 347 of National Electrical Code for underground and exposed use. Materials must have tensile strength of 55 PSI, at 70 degrees F, flexural strength of 11,000 PSI, compression strength of 8600 PSI. Manufacturer shall have five years' extruding PVC experience.

2. Liquidtight Flexible Conduit and Fittings shall be for use per Article 351 of the NEC. PVC compounds shall not include fillers. Fittings shall be manufactured from high impact PVC.

C. Rigid Metallic Conduit and Fittings:

1. ALUM rigid conduits and fittings shall 6063 alloy and conform to UL-6 and ANSI-C80.5

D. Liquidtight, Flexible Non-Metallic Conduit, Couplings and Fittings:

1. Liquidtight, flexible non-metallic conduit shall be all PVC conduit and manufactured by Thomas and Betts Co., K-Flex, Inc., or equal.

2. Fittings used with Liquidtight flexible conduit shall be of the non-metallic type as manufactured by the Thomas and Betts Co., Xtraflex System, K-Flex, Inc., or equal.

E. Flexible Couplings:

1. Flexible Couplings shall be as manufactured by the Thomas and Betts Co., K-Flex, Inc., or equal.

F. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco,, Div., Appleton Electric Co., or equal.

G. Conduit wall seals shall be Type WSK as manufactured by the O.Z. Electrical Mfg. O., or equal.

H. Combination expansion-deflection fittings shall be Type XD as manufactured by the Crouse-Hinds Co., or equal.

PART 3 - EXECUTION

3.01INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendation, in the location shown on the Drawings.

B. No conduit smaller than 1/2-inch electrical trade size shall be used, nor any have more than three 90-degree bends in any one run. Pull boxes shall be provided as required or directed. Minimum size floor conduit shall be 3/4-inch.

C. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

D. The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.

E. Conduit supports shall be spaced at intervals of 4 feet or less, as required to obtain rigid construction. Conduit straps shall be aluminum.

F. Single conduits shall be supported by means of one-hole aluminum pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with aluminum horizontal members and aluminum treaded hanger rods. The rods shall be not less than 3/8-inch diameter.

G. Conduit hangers shall be attached to structural steel by means of steel beam or channel aluminum clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.

H. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true.

I. No broken run shall exceed 500 feet in length, 75 feet for each 90-degree elbow shall reduce this length.

J. Conduit terminating in boxes shall have sealing double lock nuts and insulating bushings.

K. Conduit terminating in gasketed enclosures shall be terminated with sealing conduit hubs.

L. Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.

M. Liquidtight flexible metal conduit shall be used for all motor terminations and other outdoor equipment where vibration is present.

N. Flexible couplings shall be used in hazardous locations for all motor termination and other equipment where vibration is present.

O. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete building structure; in each conduit run which is mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit runs above ground which is more than one hundred feet long and interval between expansion fittings in such a run shall not be greater than 100 feet.

P. PVC joints shall be solvent welded. Threads will not be permitted on PVC conduit and fittings. Installation of PVC conduit shall be in accordance with manufacturer's recommendations. PVC conduit shall not be used to support fixture or equipment. Field bends shall be made with approved hotbox. Heating with flame and hand-held dryers are prohibited.

Q. Conduit installations on roofs shall be kept to a bare minimum. Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Supports to be fastened to roof using roofing adhesive as approved by roofing contractor.

R. Cables in vertical raceways shall be supported as per NEC Article 300-19. Provide and install supporting devices for cables, including any necessary accessible pullbox as required regardless if shown on drawings or not. Provide and install access panels as required. Coordinate location of pull box and access panel with the Engineer prior to installation. This includes empty raceways for future use.

S. Provide and install pullboxes, expansion fittings, junction boxes, fire barrier at fire rated walls, etc., as required by NEC whether shown on drawings or not.

T. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.

END OF SECTION

SECTION 16120

WIRES AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as hereinafter specified.

B. General Design:

1. Wire for lighting, and receptacle circuits in the administration building shall be type THHN/W solid.

2. Wire for all power feeder and motor circuits outside of the administration building shall be type THWN, stranded.

3. Single conductor wire for control, indication and metering shall be type XLP No. 14 AWG, tinned copper stranded.

4. Multi-conductor control cable shall be No. 14 AWG, stranded tinned copper.

5. Wire for process instrumentation shall be No. 16 AWG, tinned stranded.

6. Except for control and signal leads, no conductor smaller than No. 12 AWG shall be used.

1.02 QUALITY ASSURANCE

A. Standards:

1. Insulated Cable Engineers Association (ICEA).

2. Underwriters Laboratories, Inc. (U.L.)

3. American Society for Testing and Materials (ASTM)

B. Manufacturers:

1. 600 volt wire and cable.

a. Hi-Tech Cable Corp.

b. Collyer Insulated Wire Co.

c. Okonite Co.

d. Rome Cable Co.

e. American Insulated Wire Corp.

f. Triangle PWC, Inc.. Or equal

2. Instrumentation and Control Cable:

a. American Insulated Wire Corp.

b. Rome Cable Corp.

c. Okonite Co.

d. Eaton Corp. "Polyset".

e. Triangle PWC, Inc.

f. Or Equal.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All conductors shall be carefully handled to avoid kinks or damage to the insulation.

B. All conductors stored outdoors shall be covered.

PART 2 - PRODUCTS

2.01 GENERAL

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper conductors.

B. All conductors shall be stranded except lighting and receptacle circuits.

2.02 MATERIALS

A. 600 Volt Wire and Cable:

1. Type THWN PVC insulation with nylon jacket, uncoated copper, stranded, surface print, UL-83, 1063 and 758.

B. Instrumentation and Control Cable:

1. Process instrumentation wire shall be twisted pair, 600 volt, cross linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed, type "XLP". Multi-conductor cables with individually shielded twisted pairs shall be installed where indicated. Stranded tinned copper conductors.

2. Multi-conductor control cable shall be tinned stranded copper, 600 volt, cross-linked polyethylene insulated with PVC jacket, type "XLP".

C. Terminations and Splices:

1. Unless otherwise indicated on the plans, no splices may be made in the cables without prior approval of the Engineer. Where splicing is approved, the splicing material shall be as recommended and approved by the cable manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All conductors shall be carefully handled to avoid kinks or damage to insulation.

B. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. listed for use with the insulation specified.

C. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.

D. Shielded instrumentation wire shall be installed in rigid steel conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from control cables in manholes.

E. Shielding on instrumentation wire shall be grounded at one end only as directed by the supplier of the instrument.

F. Wire and cable connections to terminals, splices, and taps shall be made with compression connectors. Connections of insulated conductors shall be insulated and covered. All connections shall be made using materials and installation methods in accordance with instructions and recommendations of the manufacturer of the particular item of wire and cable. The conductivity of all completed connections shall not be less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

G. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or as approved by the Engineer.

H. Installed, unapproved wire shall be removed and replaced at no additional cost to the Owner.

I. Steel fish tapes and/or steel pulling cables shall not be used in PVC raceway systems.

J. Remove debris and moisture from the conduits, boxes, and cabinets prior to cable installation and mandrel with device of one size smaller than conduit and mandrel with wire brush one size larger than conduit.

3.02 TESTS

A. All 600-volt wire insulation shall be tested with a megohm meter after installation. Tests shall be made at not less than 1000-VDC. A cable test data form shall be provided for Engineer review.

B. All service conductors shall be tested as in Paragraph A above. These tests shall be witnessed by the Engineer.

END OF SECTION

SECTION 16130

BOXES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. Furnish and install all junction boxes, pull boxes, service entrance boxes and for a complete raceway system as shown on the Drawings and as specified herein.

B. General Design

1. Unless otherwise hereinafter specified or shown on the Drawings, all boxes and fasteners shall be type NEMA 4X, 316-stainless steel.

2. All boxes in air conditioning plenums above ceilings shall be pressed steel.

3. All boxes that do not receive devices are to have blank plates installed matching wiring device plates.

1.02 QUALITY ASSURANCE

A. Standards

1. Underwriters Laboratories, Inc. (U.L.)

2. Federal Specifications

3. American Society for Testing and Material, (ASTM)

B. Manufacturers

1. Hoffman, Type CHNFSS

2. Or Equal

1.03 SUBMITTALS

A. Materials and Shop Drawings

1. See Section 16050 - General Provisions.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Boxes and fittings shall be stored indoors protected from damage.

1.05 WARRANTY AND GUARANTEES

A. All boxes and fittings shall be warranted against defects or failure for a period of one year from date of acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Boxes shall be constructed as follows:

1. 14-gauge 316L stainless steel
2. Continuously welded and ground smooth, no holes or knockouts.
3. Seamless foam in-place gasket, watertight, dust-tight.
4. Stainless steel screws and clamps.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All boxes shall be supported away from surfaces.

B. All boxes shall be sized per the National Electrical Code (NEC)

C. All conduit entries into boxes shall not lower or change the NEMA rating of the box.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish and install wiring devices and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

2. Wiring devices shall include the following:

a. Device Plates

b. Receptacles

1.02 QUALITY ASSURANCE

A. Standards:

1. Underwriters Laboratories Inc. (UL).

2. National Electric Manufacturers Association (NEMA).

3. National Electrical Code (NEC).

B. Manufacturers:

1. Wall switches, device plates, plugs, and receptacles as follows:

a. Arrow-Hart

b. Bryant

c. Hubbell

d. Leviton

e. or Equal

1.03 SUBMITTALS

A. Material and Shop Drawings:

1. Submit material list and catalog cut-sheets for all items covered under this section. Indicate type, ratings, material, color, and manufacturer.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All devices covered under this Section shall be stored indoors, protected from damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Switches:

1. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification W-S-896-D.

2. Wall switches shall be of the following types and manufacturer or equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.

a. Single pole - Arrow-Hart, Catalog No. 1991.

b. Double pole - Arrow-Hart, Catalog No. 1992.

c. Three way - Arrow-Hart, Catalog No. 1993.

d. Four way - Arrow-Hart, Catalog No. 1994.

e. Single pole, key operated - Arrow-Hart Catalog No.1l991-L.

f. Momentary contact, 2 circuit, center off - Arrow-Hart, Catalog No. 1895.

g. Weatherproof cover for Arrow-Hart 2900 series tap action switches - Arrow-Hart Catalog No. 2881-G.

B. Receptacles:

1. Wall receptacles shall be of the following types and manufacturer or equal.

a. Single, 20A, 125V, 1P, 3W; Arrow-Hart, Catalog No 5351.

b. Duplex, 20A, 125V, 2P, 3W; Arrow-Hart, Catalog No. 5352.

c. Weatherproof, 20A, 125V, 2P, 3W; Arrow-Hart, Catalog No. 5351 and WLRD-1 cover.

d. Corrosion-resistant, duplex, 20A, 1 25V, 2P, 3W; Arrow-Hart, Catalog No. 5351 and WLRD-l cover.

e. 60A, 480V, 3P, 2W; weatherproof receptacle shall be Crouse-Hinds Catalog No. ARE6324 with Crouse-Hinds Catalog No. APJ 6385 plug.

f. Ground fault interrupter, duplex, 20A, 125V, 3P, 2W; Arrow-Hart Catalog No. GF5342.

g. Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart Catalog No. 97061.

h. Weatherproof cover for G.F.I. receptacle in FS box; Arrow-Hart Catalog No. 4501-FS.

i. Single, 20A, 125V, 2P, 3W; Arrow-Hart Catalog No. 8510BL; cover: Arrow-Hart Catalog No. 9301C indoor, 7420C weatherproof.

j. Single, 30A, 125V, 2P, 3W; Arrow-Hart Catalog No. 5716N; cover: Arrow-Hart Catalog No. 9301C indoor, 7420C weatherproof.

C. Device Plates:

1. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Receptacles in process areas and shops shall be mounted 36 inches above the floor unless otherwise noted on the Drawings.

B. Receptacles in office and other like areas shall be mounted 18 inches above the floor unless otherwise noted on the Drawings.

C. Use bolt, screws, nuts and other threaded devices having standard threads and heads so they may be installed and replaced without special tools.

D. Check light switch locations before rough-in to avoid installing a switch behind the door swing.

E. The Engineer and Owner reserve the right to change any switch or receptacle location within the same room, without added cost prior to rough-in.

F. Locate outlets intended for the supply of specific items such as water coolers, copying machines, fans, etc., as recommended by the item manufacturer.

END OF SECTION

SECTION 16150

MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish and install the motors as hereinafter specified and as called for in other sections of these Specifications.

B. Related Work Described Elsewhere:

1. Equipment: Division 11.

1.02 QUALIFICATIONS

A. Qualifications:

1. Motors shall be sufficient in size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity. Unless otherwise noted, motors driving pumps shall not be overloaded at any head or discharge condition of the pump.

2. The equipment shall be products of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

1.03 SUBMITTALS

A. The motor manufacturer shall submit to the Engineer as provided in Section 01340: Shop Drawings, Working Drawings and Samples: certified dimension prints showing nameplate data and outline dimensions.

B. Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and proper installation for a period of one year from date of acceptance. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the Contractor at no expense to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. The specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment

necessary for the proper operation of the proposed installation not mentioned in these specifications, or shown on the Drawings shall be furnished and installed.

B. The material covered by these specifications is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS AND EQUIPMENT

A. Rating:

1. Unless otherwise noted, motors 200 horsepower and below shall be of the low voltage type. Unless otherwise noted, all motors 1/2 through 200 horsepower shall be rated 230/460 volt, 3-phase, 60 Hertz A.C., premium efficient, and motors: below 1/2 horsepower shall be rated 115/230 volt, 1-phase, 60/Hertz A.C.

2. Motor connected to variable frequency drives shall be rated as inverter duty by the motor manufacturer. The motor manufacturer shall submit in writing that the motor is suitable for the drive.

B. All dripproof and weather protected Type 1 (WP1) motors shall have epoxy encapsulated windings. Small motors not readily available with encapsulated windings may be standard type, except non-encapsulated motors exposed to the outside atmosphere shall be totally enclosed.

C. All motors shall include space heaters to prevent condensation on the motor windings when the motor is not operating. The space heaters shall be sized by the motor manufacturer; maximum 200 watts; 120 volts.

D. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

E. Low Voltage, Three-Phase Motors:

1. Motors shall be of the squirrel-cage or wound rotor induction type as noted. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as called for on the Drawings and as specified herein. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFMBA standards where applicable. Motors shall be of the type and quality described by the Specifications, and/or as shown on the schedule on the Drawings, fully capable of performing in accordance with manufacturer's nameplate rating, and free from defective material and workmanship.

2. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 600 percent full load current), and low slip.

3. Motors shall be of drip proof or weather protected Type 1 or totally enclosed fan cooled construction as called for on the Drawings or specified in other sections of these specifications, with 1.15 service factor.

4. Motors shall be suitable for operation in moist air with hydrogen sulfide gas present

5. The output shaft shall be suitable for direct connection or belt drive as required.

6. Motors shall have a Class B non-hygroscopic insulation system. Class F insulation may be used but shall be limited to Class B temperature rise.

7. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.

8. All fittings, bolts, nuts, screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads.

9. All machine surfaces shall be coated with rust inhibitor for each disassembly.

10. Motor terminal boxes shall be cast iron diagonally split, one size larger than the manufacturer's standard, pipe tapped for conduit and shall be attached to the motor frame with cadmium plated hex head cap screws. The box shall be arranged for rotation so that conduit entry from either sides, or bottom is possible. Gaskets shall be supplied between the box and the motor frame and between halves of the box. Cover shall be installed with cadmium plated hex head cap screws. The box shall come completely assembled to the motor. Motor leads in the conduit box shall have the same insulation class as the windings, shall be sized in accordance with EASA suggested minimum ampacity values using 105 degree C insulated lead wire. The wiring shall be clearly identified every inch or the lead shall have a metal band in accordance with ANSI C6.1, latest revision. Nameplates shall be supplied stating the above data and permanently attached to the motor. Where the leads exit the motor frame, they shall pass through a tight fitting neoprene rubber seal to prevent foreign material or air passage and to hold the leads in a centered position. Motors shall be provided with a compression type grounding lug, mounted in the conduit box by drilling and tapping into the motor frame or by a double ended cap screw of silicon bronze.

11. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

12. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.

13. Low voltage, three-phase motors shall be manufactured by Baldor, or Relience Electric.

14. Fractional Horsepower:

    a. Fractional horsepower motors shall be rigid, welded-steel designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be reinforced, lightweight die-cast aluminum. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.

    b. Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.

    c. For light to moderate loading bearings shall be quiet all angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.

    d. For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years' normal operation without lubrication.

15. Integral Horsepower:

    a. Motor frames and end shield shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

    b. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.

    c. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.

    d. Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings shall be cast-aluminum or bar-type construction with brazed end rings.

    e. Motors shall be equipped with vacuum-degassed anti-friction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign

matter into the bearings, or leakage of lubricant out of the bearing cavity.

f. Bearings of high thrust motors will be locked for momentary up thrust or 30 percent down thrust. All bearings shall have a minimum B10 life rating of 5 years in accordance with AFBMA life and thrust values.

g. Vertical hollow-shaft motors will have non-reverse ratchets to prevent backspin.

F. Inverter Duty Motors:

1. In addition to the requirements of 16150-2.02 A.B.C. and E., motors intended for use with variable frequency drives shall be inverter duty motors specifically designed for inverter operation, and shall be applied in accordance with MG, NEMA, ANSI, IEEE, AFBMA AND NEC for the duty imposed by the driven and drive equipment. Inverter duty motors shall be specifically certified by the motor manufacturer to be compatible with the variable frequency drive to be used with the motor. Inverter duty motors shall be designed to operate over a frequency range of 0 to 66 Hertz. Motor insulation for all motors operating with variable frequency drives shall be Class H with Class F temperature rise when operated with the inverter continuously at all speed and load conditions throughout the specified operating range. Insulation systems shall be capable of withstanding a change in voltage (dV/dT) of 1600 volts per microsecond without damage. Motors rated less than 200 horsepower shall be protected with two normally closed thermal protectors in the stator winding and shall be set to open when the temperature reaches 155 degrees C. Motors rated 200 horsepower and greater shall have platinum RTD overtemperature protection The motor frame shall be cast iron. Inverter Duty motors shall be Baldor Inverter Drive Motors, Reliance Electric or US Motors.

2. Motors shall be suitable for operation in moist air with hydrogen sulfide gas present

3. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

4. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

5. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.

G. Low Voltage, Single Phase Motors:

1. Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm called for on the Drawings. Motors shall be rated 115/230 volts, 60 Hertz, single phase,

open, drip proof, or totally enclosed fan cooled as called for on the Drawings or other sections of these specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.

2. Totally enclosed fan cooled motors shall be designed for severe duty.

3. Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protecting plating.

4. Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Motor connections: All motors shall be connected to the conduit system by a means of a short section (18 inch maximum) of flexible conduit unless otherwise indicated. For motor connections of No. 6 AWG and smaller wire size, the Contractor shall furnish flexible conduit with an approved grounding conductor inside the flexible section. For motor connections of No. 4 AWG or larger wire size, the Contractor shall install a grounding conductor in the conduit and terminate at the motor control center with an approved grounding clamp.

3.02 INSPECTION AND TESTING

A. The following tests shall be performed on all motors after installation but before putting motors into service.

1. The Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor. The following table gives minimum acceptance insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one minute of megger test run.

Winding Temp (F°)	115V.	230V.	460V.
37	60	108	210
50	32	60	120
68	13	26	50
86	5.6	11	21
104	2.4	4.5	8.8
122	1	2	3.7
140	.50	.85	1.6

2. The Contractor shall check all motors for correct clearances and alignment and for current lubrication, and shall lubricate if required in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

END OF SECTION

SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required and install all panelboards as hereinafter specified and as shown on the Drawings.

1.02 QUALITY ASSURANCE

A. Standards:

1. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

B. Manufacturer (NEMA 1):

1. 120/240V, single phase, 3 wire, and 120/208V three phase, 4-wire panelboards shall be as manufactured by the Square D Co., or. Cutler/Hammer

2. 480V, three phase, 3-wire panelboards shall be as manufactured by the, Square D Co., I-Line or. Cutler/Hammer

C. Manufacturer (NEMA 3 and 12):

1. NEMA 3 and 12 panelboards shall be type NLP as manufactured by the Crouse-Hinds Company or equal.

PART 2 - PRODUCTS

2.01 RATING

A. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2.02 CONSTRUCTION AREA (NEMA 1)

A. Interiors:

1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing panel type, number of circuit breakers, ratings and source.

B. Buses:

1. Bus bars for the mains shall be of tin-plated copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole circuit devices shall be arranged for sequence phasing of the branch circuit devises. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

C. Boxes:

1. Recessed boxes shall be made from galvanized code gauge steel without multiple knockouts. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.

2. Surface mounted boxes shall have an internal and external finish as hereinafter specified in Paragraph D4.

3. At least 4 interior mounting studs shall be provided.

4. All conduit entrances shall be field punched.

D. Trim:

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed

alike; directory frame and card having a transparent cover shall be furnished on each door.

3. The trims shall be fabricated from code gauge sheet steel.

4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

5. Trims for flush panels shall overlap the box by at least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

2.03 CONSTRUCTION (NEMA 4X)

A. Interiors and Buses:

1. Interiors and buses shall be as hereinbefore specified for NEMA 1 construction.

2. Interior trim shall be complete. No exposed wiring allowed.

B. Boxes and Covers:

1. Boxes and covers shall be made from stainless steel.

2. Boxes and covers shall be hinged together and gasketed. All metallic parts on exterior shall be stainless steel.

3. Conduit openings shall be sealed with lock rings or sealing washers.

4. Polycarbonate or plastic enclosures or boxes are unacceptable.

2.04 CIRCUIT BREAKERS

A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

B. Circuit breakers shall be molded case, bolt-in type, for NEMA 1 and plug-in for NEMA 4X.

C. Circuit breakers used in 120/240 and 120/208V panelboards shall have an interrupting capacity of not less than 22,000 amperes, RMS symmetrical.

D. Three pole breakers used in 480V panelboards shall have an interrupting capacity of not less than 25,000 - amperes, RMS symmetrical.

E. GFCI:

1. GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case,

bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and in interrupting capacity of 10000 amperes RMS.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2 inch air space between the box and the wall.

B. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6-feet 0-inch above the floor, properly aligned and adequately supported independently of the connecting raceways.

C. All wiring in panelboards shall be neatly formed, grouped, laced and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the card holder inside the front cover.

END OF SECTION

SECTION 16370

PULSE VARIABLE SPEED DRIVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. Furnish speed drives for use by three (3)-75 horsepower motors including all appurtenances required and specified herein.

2. All equipment and accessories shall have approved manufacturer's shop drawings and shall be tested in conformance with these Specifications prior to acceptance and final payment by the Owner.

1.02 QUALITY ASSURANCE

A. Variable speed drives shall be sufficient size for the duty to be performed and shall not exceed their full-rated capacity when the driven equipment is operating as specified. Variable speed drives driving pumps shall not be overloaded under any operating condition of the pump.

B. Standards

1. National Electrical Manufacturers Association (NEMA).
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
3. American National Standards Institute (ANSI).
4. National Electric Code (NEC).

C. The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:

1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
2. All printed circuit boards shall be tested at 50 degree C for 50 hours. The VFD manufacturer shall provide certification that the tests have been completed.
3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.
4. The VFD systems shall be fabricated by the same VFD manufacturer; parties other than the VFD manufacturer must not fabricate items in whole or in part. Third party distributor or packaged modifications to a standard product will not be allowed.

D. Approved Manufacturers:

1. ABB (Owner knows no equal)

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment shall be maintained in an upright position at all times. Lifting shall be only at the floor sills or the top mounted lifting angles.

B. Equipment shall be protected against damage at all times. Any damage to the paint shall be carefully repaired using touch-up paint furnished by the VFD Manufacturer.

C. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.04 SUBMITTALS

A. Submit detailed drawings concerning each drive and all components including:

1. Provide cabinet assembly and layout drawings to scale.
2. Provide fabrication specifications with materials of construction of all components.
3. Point-to-point wiring diagrams depicting wiring within the panel and connection to external devices. Freehand drawings are unacceptable.
4. Catalog cut-sheet on all panel components with manufacturer's complete model number.

B. Data sheet and drawings shall be provided with an index and proper identification and cross-referencing. Each drive shall be submitted in its entirety.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY ADJUSTABLE SPEED DRIVES (VARIABLE TORQUE, PWM)

A General

1. The inverter drive will be powered from a 460 Volt, three-phase, 60 HZ bus, with maximum voltage variation of $\pm$10% and maximum frequency fluctuation of $\pm$2HZ. The VFD shall be capable of operation on a system with 5% Total Harmonic Distortion (THD) present. The VFD output voltage will be varied proportionally to the output frequency to maintain a constant V/Hz up to the nominal 60-hertz. Above 60 hertz, the output voltage shall be constant.

2. The drive shall be suitable for operating standard NEMA Design B motors. The drive shall be a 18 pulse (min) design consisting of an input phase shifting isolation device and input full-wave triple diode bridge rectifiers to convert incoming fixed voltage/frequency to a fixed DC voltage. This will minimize the generation of harmonics and electrical noise back into the line providing a displacement power

factor of 0.95. The adjustable speed drive system shall also include a filter network and a transistorized inverter section. The Drive manufacturer will also manufacture the Transistors used in the inverter section of the drive. The output will be a sinusoidal wave, pulse width modulated (PWM) voltage waveform for reduced harmonic heating in the motor. Each drive shall include diode rectifiers as the standard input device.

B. Service Conditions

Input Power:	460VAC, ±10%, 3 phase, 60 Hz, ±2 Hz.
Ambient Temperature:	-10 to 40°C (14 to 104°F)
Storage Temperature:	-20 to 60°C (4 to 140°F)
Relative Humidity:	0 to 95% Non-Condensing
Vibration:	Acceleration at 0.5 G maximum (20-50 Hz). Amplitude at 0.1mm maximum (50-100 Hz).
Altitude:	0 to 3300 Ft
Motor Lead Length	100 ft in steel conduit

C. The drive shall be capable of 100% full load continuous output with 115% overload rating for one hundred ten (110) seconds.

D. In the event of a sustained power loss, the control shall shut down safely without component failure. Upon return of utility power, the system shall be capable of automatically returning to normal operation. In the event of a momentary power loss, the control shall shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation. The drive shall be capable of starting into a rotating motor in either direction.

E. Minimum drive efficiency for NEMA 1 assemblies: 97% or better at motor base speed and rated torque. Losses shall include all control power and cooling system losses associated with the drive

F. Displacement power factor: 95 percent or higher throughout the entire operating speed range, measured at drive input terminals.

G. Output frequency drift: No more than ±0.5% of maximum frequency.

H. Power transistors to be Insulated Gate Bipolar Transistors (IGBT's) with a PIV rating of 1200 volts minimum.

2.02 CONSTRUCTION

A. Each drive shall be designed for stand-alone operation. Multiple drive units shall not utilize shared components. The drive shall be housed in a free standing, front accessible, general-purpose indoor enclosure rated NEMA 1. Cabinets shall be single or multi-bay, sheet steel with hinged doors. Doors will have concealed hinges with lockable through-the-door handle operator mechanism.

B. Provisions shall be made for top or bottom entry/exit of incoming line power cables, outgoing load cables and control wiring.

C. Each VFD shall have a molded case, circuit breaker type main power disconnect switch, with an external operating handle. The circuit breaker shall have a minimum short circuit rating of 25,000 amperes RMS symmetrical interrupting capacity and shall be labeled in accordance with UL Standard 489.

D. The following safety features shall be standard on all drives:

1.) Provisions to padlock main disconnect handle in the “OFF” position.

2.) Mechanical interlock to prevent opening cabinet door with disconnect in the “ON” position, or moving disconnect to the “ON” position while the unit door is open.

3.) Auxiliary contact on main disconnect to isolate control when fed from external source.

4.) Barriers and warning signs on terminals that are energized with the power disconnect “OFF”.

E. The drive manufacturer will also manufacture the Insulated Gate Bipolar Transistors used in the inverter section of the drive. Additionally, the manufacturer will have a minimum of 5 years experience in Integrated Bi-polar Transistor technology.

2.03 CONTROL WIRING

A. Wiring: 600 volt, stranded copper. 90 degrees C color-coded insulation, minimum size No. 16 AWG (120VAC control power only).

B. Identification and termination: Crimp type wire lugs with sleeve type markers at each termination point. Provide numbered terminal blocks for external connections.

C. Control power: Provide a 120VAC, fused, control power transformer for cooling fans and external control circuits when required. All control circuits shall be isolated from power circuits.

2.04 OPERATOR INTERFACE

A. Provide a door-mounted digital keypad/display, capable of controlling the drive and setting the drive parameters. The digital display will have a 7-segment, 4-column LED that will normally display:

1. Frequency in Hertz
2. Control mode - manual or automatic
3. Display of drive’s set output frequency.

4. Output voltage in percentage of VFD's output voltage.
5. Output current in percentage of VFD's output current. Automatically adjusted if the electronic overload is adjusted.

B. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. A user menu shall be provided as a guide to parameter settings. These parameters shall be adjustable for specific project application requirements on site. All setup operations and adjustments will be digital, stored in non-volatile (EEPROM) memory. No analog or potentiometer adjustments will be allowed. The variables stored in EEPROM shall be transferable to new and spare boards. As a standard feature, these variables shall be protected from unauthorized tampering, revision, or adjustment by a personal lockout code.

C. The digital keypad shall have 11 keys to provide easy programming of the drive. These keys shall include:

1. Up and Down arrow keys to increase or decrease output frequency or data values.
2. Manual/Off/Auto keys for selection of control mode.
3. Run and Stop keys for starting and stopping in the manual mode.
4. Fault clear/reset key for quick reset of fault conditions.
5. Program key to enter the program mode and adjust parameters.
6. Read/Write key for changing parameters in the program mode.
7. Quick setup key that allows access to setup parameters only and will return to the frequency mode after all parameters have been stepped through.

2.05 OPERATIONS AND FEATURES

A. Make provisions for field adjustment of the following parameters through the digital keypad:

1. Current limit and torque boost.
2. Maximum voltage level.
3. Minimum/Maximum speed, Volts/Hertz, Upper and Lower Limit.
4. Independently adjustable acceleration and deceleration rates.
5. Electronic thermal overload.
6. Coast, controlled ramp or DC injection selectable modes of stopping.
7. PID setpoint control selection (field selectable).

B. Make provisions to accept a remote dry contact closure to start and stop the drive(s) while in the Auto mode from the drive control system.

C. Make provisions to accept an isolated analog input speed reference of 4-20mA and be adjustable via the digital keypad. Bias and gain shall be provided.

D. The 4-20mA analog input speed reference signal will be galvanically isolated. Calibration adjustments shall be provided within the speed ranges specified in Paragraph 2.01.C.

E. Provide the following short circuit and input protective features:

1. High speed current limiting fuses rated 200,000 AIC, specifically designed for solid state applications.

2. Solid state instantaneous overcurrent trip set at 180%.

3. Undervoltage protection with automatic restart.

F. Provide the following internal protective features.

1. Transient surge protection using metal oxide varistors (MOV's).
2. Transistor overtemperature and overcurrent protection.
3. Current limit comparator circuit to automatically phase back the output current and frequency to prevent excessive currents from damaging motor insulation.
4. DC bus fuse protection.
5. DC bus overvoltage trip.

G. Provide the following output protective features.

1. Inverse time motor overload protection. Adjustable from 10% to 100%.
2. Static overspeed protection.
3. Stall protection on overload with inverse time overcurrent trip. Current limit shall be adjustable from 10% to 120%.
4. Protection against opening or shorting of motor leads.
5. Critical frequency avoidance circuit. Three set points selectable from 0 to maximum frequency. Bandwidth of set points to be adjustable from 0-30HZ.
6. The drive shall have one (1) input contactor connected to the load side of the main breaker. The control of the input contactor shall be a function of incoming power quality as monitored by a phase monitor to protect the drive in the event of undervoltage, overvoltage, phase loss, phase shift, phase unbalance, frequency shift. The input contactor shall open for a field adjustable time until proper incoming power is detected.

H. Provide the following project specific features.

1. Enclosure space heaters with thermostat for condensation control.
2. Power supply and controls related to motor space heaters
3. Control alarm relays related to the motor thermostats.
4. Signal required by remote monitoring and control
   a. Drive Failure, 120VAC, 5 amp contacts, Form C.
   b. Drive Run, 120VAC, 5 amp contacts, Form C.
   c. Drive In Remote, 120VAC, 5 amp contacts, Form C
   d. Drive In Manual, 120VAC, 5 amp contacts, Form C
   e. Drive Speed, 0-100%, 4-20mA DC.
   f. Drive Speed Command, 0-100%, 4-20mA DC

I. For test purposes, it shall be possible to run the drive with no load (the motor is disconnected from the drive output.

2.06 DIAGNOSTIC AND FAULT CAPABILITY

A. The following conditions shall cause an orderly drive shutdown and lockout.

1. Overcurrent at start-up.
2. Instantaneous overcurrent.
3. Overtemperature of VFD or external fault.
4. Ground Fault.
5. Blown input fuse.
6. Control Power supply failure.

2.07 FACTORY TESTS:

A. The drives will be completely assembled, wired, and tested. The following tests will be performed:

1. Upon completion of manufacture and assembly, the drives shall be subjected to a complete factory test to demonstrate compliance with specified features and characteristics. The purchaser at his option shall be able to witness factory testing of his unit, with factory coordination.

2. The testing procedure shall be the manufacturer’s standard procedure to assure maintenance free service. The buyer shall be given a 5-day notice prior to the start of factory testing for the buyer's representative to witness the testing.

3. All equipment, devices, instrumentation, and personnel required to perform the factory tests shall be supplied by the manufacturer. Upon satisfactory completion of the test, the seller shall upon request submit two (2) certified copies of the test report to the buyer. Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.

2.08 SERVICE

A. The drive manufacturer shall guarantee the operation of the drive against failure due to defects for 18 months after shipment or 12 months of service, whichever comes first.

B. The drive manufacturer shall supply a recommended list of spare parts and pricing.

PART 3 - EXECUTION

3.01 INSTALLATION BY ELECTRICAL CONTRACTOR

A. Field wiring shall be per manufacturer's recommendation.

B. The manufacturer shall include in his bid one (1) normal workday per drive of a qualified service engineer's time. This time will be used to ensure proper connection and functioning of the equipment prior to startup and to train Owner personnel in the use of the equipment.

3.03 INSPECTION AND TESTING

A. The drive manufacturer shall test the drive controller with a motor load prior to shipment.

B. The drive manufacturer shall furnish a certified field test report demonstrating installed compliance for voltage and current distortion at the required point of common coupling under utility power.

C. A copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the Owner.

END OF SECTION

SECTION 16900

PROCESS INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 - GENERAL

A. DESCRIPTION

1. General

a. This part of the Contract Documents covers the general requirements for the furnishing and installation of a Primary Instrumentation, Control, and Monitoring System complete in every detail for the purposes specified and shall form a part of any other technical specifications supplied unless otherwise specified. The Instrumentation, Control and Monitoring System shall include a digital base data acquisition system to communicate with the remote central computer via radio. In addition, the Instrumentation, Control and Monitoring System shall include the control and monitoring of the proposed pump station and storage system for the City of Titusville Armstrong Booster Pump Station.

b. The intent of this specification is to require that the Primary Instrumentation, Control and Monitoring System including all Sections of this Specification, i.e., primary elements, panel mounted and miscellaneous field instruments, etc., shall be furnished by a single Primary Instrumentation and Control System Supplier (aka Supplier) to assure system uniformity, subsystem compatibility and coordination of all secondary system interfaces. Where specific manufacturers are designated, substitutions will not be accepted. Deviations may be considered in special circumstances but must be approved by the Owner. The Contractor shall include in his bid, the name of the Primary Instrumentation and Control System Supplier that will be used to furnish the system as described herein. The Primary Instrumentation and Control System Supplier shall be required to start work within 20 working days after the award of the contract to the Contractor.

2. Approved Primary Instrumentation and Control System Supplier:

a. Curry Controls, Lakeland Florida

b. Rocha Controls, Tampa Florida

c. Substitute Control and Monitoring System Supplier:

1. Provisions have been made in the Proposal form for submission of substitute proposals for the Primary Instrumentation, Control and Monitoring System Supplier. The Engineer will consider substitutions submitted by the Contractor in the Proposal. Should the substitute be determined "not acceptable" by the Engineer, then the Contractor must contract with one of the pre-qualified Primary Instrumentation, Control and Monitoring System SupplierS.

2. A substitute Primary Instrumentation, Control and Monitoring System Supplier may be deemed "acceptable" if the proposed system is the same or better than those of the pre-qualified Primary Instrumentation, Control and Monitoring System SupplierS in function, performance,

reliability, quality, and general configuration. Solely the Engineer will make determination of "acceptable" in reference to the requirements of this project.

3. No substitute Primary Instrumentation, Control and Monitoring System Supplier will be considered unless, in the opinion of the Engineer, their proposed system conforms to the Contract Documents and Specifications in all respects, except for make and manufacturer and minor details.

4. In order that the Engineer may determine if the proposed substitute is satisfactory, a Proposal shall be SUBMITTED WITH THE BID FORMS. The form and content of the Proposal shall conform to the requirements of PROPOSAL CONTENT hereinafter. This does not apply to the pre-qualified Primary Instrumentation, Control and Monitoring System Supplier.

5. Owner selection based on the Proposal does not exempt the Primary Instrumentation, Control and Monitoring System Supplier from meeting all the requirements of the Contract Documents nor does it give any prior acceptance of any subsystem, equipment, materials, or services. The Contract Documents are the final authority for acceptance of the work provided. The pre-qualification Proposal is not a part of the Contract Documents. The pre-qualification Proposal does not exempt the Primary Instrumentation, Control and Monitoring System Supplier from the requirements of SUBMITTALS hereinafter.

6. Information contained in the Proposal will be considered to be confidential, and reasonable precautions will be taken to ensure the security of these Documents. All data submitted will become and remain the property of the Owner; none will be returned.

7. Proposal Content:

   a) Block Diagram: Provide a block diagram for the proposed Control System showing all major components and their interrelationships.

   b) Overview Description: Provide a one (1) page overview description of the proposed Control System. This description shall cover the Computer System and the Programmable Controller Subsystem. The emphasis shall be on explaining the Block Diagram, the functions of the individual subsystems, and the communication between subsystems.

   c) Equipment Lists: Provide complete equipment lists for all major equipment items. For each equipment item, include the following:

      1) Equipment identification codes and name as shown in the specifications.

      2) Equipment name and model numbers used by the Primary Instrumentation, Control and Monitoring System Supplier to refer to this equipment.

3) Name of actual equipment manufacturer and associated model number (if applicable).

4) Catalog Cuts: Provide a complete set of catalog cuts for all equipment shown in the equipment lists. Do not include catalog cuts for equipment that are not specific to this project. Indicate proposed options, sizes, speeds, etc., on the catalog cuts by highlighting or encircling.

5) Modifications to Standard System: Provide a list of changes and additions that will be required to the Primary Instrumentation, Control and Monitoring System Supplier 's "standard" hardware and software in order to meet these Contract Documents. Here the term "standard" refers to the Primary Instrumentation, Control and Monitoring System Supplier's subsystems as described in his user's manuals, catalog cuts, and other references. This list shall reference the applicable Specification paragraph number and include a description of the proposed changes to the Primary Instrumentation, Control and Monitoring System Supplier's standard hardware and software.

6) Technical Questionnaire: Provide a clear and complete response to each of the following questions and statements. The response to a technical question may be partially described in a user manual. If a reference to other material is used, provide a brief summary or overview of how the referenced material answers the question. If a reference is used, cite the reference with the manual name, page number(s), and paragraph or section name. A referenced user manual must be included with the set of user manuals submitted. Responses to the questions in this Section shall be in the same order as the questions. Each response shall identify the subject and question number being answered.

a) System Questions:

(1) Provide a comprehensive description of the proposed Control System communication protocol. Include in the description the message structure and security features. Also, provide an annotated calculation of the Control System response time. Describe any consequences of the loss of any PLC in the Control System.

b) Central Control Subsystem Questions:

(1) List the name and version number of the proposed operating system.

(2) What software configuration steps are required to define a new personal computer for connection to the Control System?

(3) What software configuration steps are required to define new I/0 points for an existing personal computer?

(4) Provide several examples of both standard CRT displays and special graphic displays used on typical projects.

(5) What method(s) are used for CRT target selection?

(6) Outline the structure of the main "Data Collection" disk files.

(7) Describe historical multi-point trending and provide examples of historical CRT trends and color graphics printer trends.

c) Programmable Controller Subsystem Questions:

(1) Provide a detailed description of the following proposed communication systems:

Computer to PLC Communications.
Remote I/O Communications

(2) Provide examples of the methods that will be used to document ladder logic programs.

(3) What is the size and type of cable used for the Control System data highway, the peer-to-peer communications, and the remote I/0?

7. Project Schedule: The Primary Instrumentation, Control and Monitoring System Supplier must be completed in time to support the pump station process controls. Provide a brief milestone schedule for implementation of the system based on the Contract duration stated in the Contract. List the major milestones, and discuss any anticipated problems and their solutions.

8. Statement of Experience: Provide a list of at least three control systems comparable to the system specified which has been furnished and placed into operation by the prospective Primary Instrumentation, Control and Monitoring System Supplier. For each system, provide the following information:

a) Owner's name, address, telephones number, and name of current operations supervisor or other contact.

b) Description of the Control System hardware configuration including major equipment items and number of I/O points.

c) Control System block diagram.

d) Summary of Control System software and major data acquisition and control function.

e) Dates when Contract was signed, equipment was delivered, and Owner accepted system. State also the originally scheduled completions date and if different from the actual date, explain why.

f) Approximate value of the listed Control System provided in US dollars.

9. Financial Statement: Provide a financial statement consisting of the prospective Primary Instrumentation, Control and Monitoring System Supplier's most current and the previous year balance sheet. If the Primary Instrumentation, Control and Monitoring System Supplier is a division or a subsidiary of a parent organization, the financial statement should reflect only the prospective Primary Instrumentation, Control and Monitoring System Supplier division or subsidiary's contribution to the parent company's financial statement.

10. Organization Chart:

a) Provide an organization chart showing the organization structure to be used for this project. Identify all key personnel who will actually be assigned to do this project. Identify any separate organizations that will supply any of the subsystems. For each subsystem, identify the organization and key personnel that will supply the specified maintenance.

b) Include a summary of the total number of engineers, systems analysts, programmers, technicians, trainers, draftsmen, and installation personnel currently employed by each organization.

11. Qualification of Personnel:

a) Provide resumes giving management and technical qualifications of supervisory, local service representative, and all key personnel shown on the organization chart.

b) For each maintenance organization, identify the location of the base of service and how the required coverage will be achieved.

12. Basis of Evaluation:

a. The Owner and Engineer will use the Proposal information to evaluate the prospective Primary Instrumentation, Control and Monitoring System Supplier. No evaluation of the Proposal will be made prior to the receipt of the bids.

b. Some of the factors to be used in the evaluation will be:

1) Conformance with the terms of the Contract Documents.

2) Overall quality of products proposed.

3) Responsibility, experience, and qualifications of the Primary Instrumentation, Control and Monitoring System Supplier including the maintenance organization.

4) The Contractor's Proposal price for the system.

5) Any submittal failing to clearly present all of the requested information, or failing to be in the requested format may be considered non-responsive and rejected.

2. Scope of Work:

a. Furnish and install all instrumentation and control systems hereinafter specified to perform the intended function. Work shall include all labor, materials and equipment, performance of all work necessary to complete the manufacture, to make factory tests, to prepare and load for shipment, to deliver to the site, to provide programming, calibration, installation supervision, system start-up, services and incidentals required to completely furnish and install a programmable controller based control and data acquisition system with instruments and control devices for the automation of the Reuse System including all work necessary during the Warranty Period, as specified herein: Warranties and Bonds, and shown on the Contract Drawings. The installation of the system hardware shall be by the Contractor with the supervision by the instrumentation and control Instrumentation System Supplier.

b. Furnish all tools, equipment, materials, and supplies and perform all labor required to complete the furnishing, installation, validation, start-up and operational testing of a complete Instrumentation, Control and Monitoring System as specified herein.

c. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided under other Sections of this Specification, shall be included whether specified or not.

d. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions and recommendations of the equipment Manufacturer as approved by the Engineer.

e. Instruct and coordinate with the Contractor all installation and landing of control and instrumentation wiring related to the Primary Instrumentation, Control and Monitoring System.

B. QUALITY ASSURANCE

1. General

a. The Primary Instrumentation, Control and Monitoring System as specified in this Specification is an integrated system and therefore shall be provided by a competent, qualified instrumentation and control system supplier who shall have total responsibility for the work of this Specification. Entire system installation including process parameter verification, calibration, validation, start-up, testing, and training shall be performed by qualified personnel, possessing all the necessary equipment and who have had a minimum of 5 years experience in engineering, programming and installing of similar instrumentation, control and monitoring systems. The system shall be integrated using the latest, most modern and proven design and shall, as far as practical, be of one supplier.

b. The Primary Instrumentation, Control, and Monitoring System Supplier shall be responsible for the correct selection of all instrumentation and installation of all hardware and secondary systems specified in this Specification.

c. Prior to the selection of any device, coming in contact with the process, actual on-site process conditions and the suitability of the device and materials of construction for the stated application shall be verified with the original equipment manufacturer by the Instrumentation and Controls Systems Supplier. Unless notified in writing all devices and component part numbers, when provided, shall be assumed to have been verified as having been selected based on actual process parameters and application. Ultimately, the Contractor shall be responsible for all cost associated with replacements and delays due to improper equipment selection.

d. The Primary Instrumentation, Control, and Monitoring System Supplier shall be responsible to see that all components of the primary as well as secondary Control Systems, including measuring, indicating, transmitting, receiving, totaling, controlling, alarming devices and all appurtenances are completely compatible, correctly sized for actual process conditions, and properly interface to each other and shall function as outlined. The primary Instrumentation, Control, and Monitoring System Supplier shall furnish and install such additional equipment, accessories, etc. as are necessary to meet these objectives at no additional cost to the Owner.

e. The Primary Instrumentation, Control, and Monitoring System Supplier shall, in fact, be an Owner recognized supplier of instrumentation, control panels, and systems, etc., of the general type and complexity of the system specified herein and shall have been regularly engaged in providing and engineering instrumentation, control, and monitoring systems on a single system responsibility basis for a minimum of 5 consecutive years. The personnel employed for system engineering, supervision, start-up, operational testing and training shall have been regularly employed and factory trained by the Instrumentation, Control, and Monitoring System Supplier for a minimum of 2 years.

f. A detailed description of the experience of each engineer that will be assigned for the duration of the project shall be submitted for review and approval by the Owner. The Suppliers lead instrumentation engineer shall be a electrical engineer specializing in the selection and implementation of instrumentation, control, and monitoring systems of the type specified herein for the past 5 consecutive years. References shall be provided for all projects successfully completed by each engineer or software programmer assigned to this project.

g. Actual installation may or may not be performed by the Suppliers employees but the Primary Instrumentation, Control, and Monitoring System Supplier shall be responsible for the technical supervision of the installation to insure that it is proper in all respects.

h. Secondary control systems include all instrumentation, switchgear, and controls (including but not limited to gauges, transmitters, panels, process and manual switches, indicators, controllers, etc.) existing or furnished under sections other than this section, and are generally considered as a "packaged" system supplied specifically for the equipment being specified under that section.

i. Major constituents of each secondary system shall include, but not limited to, all materials, equipment, and work required to implement a complete and operating system of instrumentation and controls for its associated equipment. The systems shall include primary elements for process variable measurements, analog display and control elements, and discrete display and control elements as noted hereinafter and in the referenced Specification sections.

j. Qualifications of the secondary system suppliers engineers shall be as specified herein above unless otherwise noted. The Owner reserves the right to reject the use of any supplier not meeting the qualifications specified herein and under the specific equipment specification.

C. RESPONSIBILITY

1. General

a. The Contractor shall be ultimately responsible and shall provide for the verification of process conditions, supply, installation, certification, adjustment, and start-up, of complete, coordinated systems which shall reliably perform the specified functions.

b. All interconnecting conduit and wiring, between elements of a single secondary control system shall be furnished, installed and connected under the same section as is the secondary control system unless the electrical drawings specifically indicate otherwise.

c. All other electrical conduit and wiring are provided, installed and connected under Division 16, ELECTRICAL.

D. PRE-SUBMITTAL CONFERENCE

1. General

a. The Contractor/Supplier shall arrange a pre-submittal conference with the Owner or his representative within sixty (60) days after award of the Contract for the

purpose of informally discussing in detail and verifying the correctness of the Contractor/Supplier's proposal, engineering methods, equipment, and to generally provide a framework for communication and coordination. This meeting shall be attended by the Contractor/Supplier's Engineers, and duly authorized representatives of the Owner.

b. The Contractor/Supplier shall prepare a project schedule and identify all major milestones in accordance with the project requirements.

c. The Contractor/Supplier shall prepare a draft copy of the material that will be submitted for Owner's review. The draft shall include the following, as a minimum:

i. Listing of major items proposed. Identify items by tag number, description, function, manufacturer, model number, descriptive literature and statement as to whether item is "as specified or equivalent". Items identified as "equivalent" shall be accompanied by a comparative listing of the published specifications for the item specified and for the item proposed.

ii. Prior to making any submittals, the Contractor/Supplier shall submit to the Owner, a listing of all electrical components, assemblies and panel(s) that are intended to be furnished that are not UL approved or recognized or that does not comply with any other Owner recognized third party approval agency. The Supplier is directed to utilize UL approved and recognized components, panel(s), and assemblies when available.

iii. Review and approval of all unlisted electrical devices, by the Owner, is required prior to manufacturing. Any additional costs associated with materials, installation of those materials, and special on-site inspections necessary to meet the applicable NEC and local electrical codes shall be arranged by and borne by the Supplier.

E. ENGINEERING SUBMITTALS

1. Before proceeding with any manufacturing, submit the following for approval in complete bound sets indexed by specification number. Describe and verify all component part numbers for the items being submitted. Submit only complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with all components identified by a unique tag reference in accordance with ISA-S5.1 Instrumentation Symbols and Identification. Terminal number identification associated with relays, lights, electrical devices, etc., shall be clearly identified on all drawings. Submit fabrication drawings, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing all equipment and tag numbers for all components. Submit panel graphic drawings when applicable. Include material specifications listed where applicable.

2. Include a draft of the theory of operation for all relay circuits including software logic implemented via programmable controllers, that will eventually be included in the operation and maintenance instruction manuals required below.

3. Each submittal shall be bound in a white, standard three ring, clear view type, hard cover binder which indicates the system name, submittal content, project reference, revision

date and purpose of the submittal on the spine as well as the cover which shall also include the owners name, location, and supplier's name. Binders shall not exceed three inches in thickness.

4. Provide a minimum of eight (8) copies of each of the following submittals to the Owner for review and approval:

   a. Hardware Submittal

      i. Index and Comments

         (a) Provide a detailed index identifying each tabbed section and its content.

         (b) If there are any deviations or clarifications to the specifications, they shall be documented in writing in this section. If there are no comments or concerns identified in the submittal, it will be presumed that there are no deviations from the Contract Documents for the system being furnished.

      ii. Component Data Sheets

         (a) Component Data Sheets shall be specifically prepared for all components being furnished under these Specifications. The purpose of this material is to supplement the generalized catalog information by providing the specifics of each component (e.g., individual component tag ID reference, service, quantity supplied, part number, breakdown and descriptions for all options, scales, ranges, materials of construction, component location reference, and reference to associated drawings).

         (b) Include such other necessary data as would provide a complete and adequate specification for re-ordering an exact duplicate of the original item from the manufacturer at some future date. More than one tag numbered item with the same part number may be included on a sheet.

      iii. Catalog Cuts

         (a) Manufacturer's standard specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Standard manufacturer catalog information, descriptive literature, wiring diagrams, and shop drawings shall be provided for all devices, whether electrical or mechanical, furnished under these Specifications. This includes, but is not limited to, pressure switches, gauges, solenoid valves, controllers, indicators, power supplies, switches, lights, relays, timers, circuit breakers, fuses, etc.

iv. Sizing Calculations

(a) Complete certified sizing calculations shall be provided for all control valves and flow elements. The calculations shall include the process data used, minimum and maximum values, permanent head loss and all assumptions made. Equations shall be submitted for all computing modules and function generating modules and shall include the actual scaling factors and units used.

v. System Hardware Submittal Format

(a) Tab 1. Component Index and Comments

(b) Tab "N" through "NN" (as required)

(c) Component "X" Data Sheet(s) - one tab shall be provided per each component type and shall include the standard manufacturer catalog information and sizing calculations (when required).

b. System Control Panel(s) Drawing Submittal

i. All drawings shall be provided on "B" size paper and shall be laser generated with a 300 DPI resolution, tabbed, and bound as directed above. Drawing submittal may be combined with the Hardware submittal providing the binder capacity is not exceeded.

(a) Index and Comments

(1) Provide a detailed index identifying each tabbed section and its content.

(2) If there are any deviations or clarifications to the specifications, they shall be documented in writing in this section. If there are no comments or concerns identified in the submittal, it will be presumed that there are no deviations from the contract documents for the system being furnished.

(b) Panel Layout Drawings

(1) Provide detailed shop drawings for all panels and enclosures. Drawings shall show the location of all exterior and internal panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show all major dimensions, front, back, side, and mounting details, as well as all elevations, in inches from the base up, of all rows of components.

(2) The panel legend shall list and identify all front of panel devices by the components unique tag identifier, all nameplate inscriptions, service legends, and annunciator inscriptions when applicable. Service legends, and

nameplate inscriptions shall show size, engraving per line, character height and color. Information may be included on the layout drawing if spacing permits.

(3) The bill of materials shall include all components mounted within or on the panel that are not listed in the panel legend, and shall include the component identification tag, description, manufacturer, and complete part number for re-ordering. Information may be included on the layout drawing if spacing permits.

(4) Fabrication drawings shall be submitted for review and shall show all cut-out dimensions, support details, brackets, materials of construction, finish, etc. to be used for fabrication of each panel. Fabrication drawings may be submitted separately after the layout drawings have been approved. Construction of panels shall not be started until the approval of the fabrication drawings is received.

(c) Detailed Panel Wiring Diagrams

(1) Wiring diagrams shall be provided in the form of ladder type schematics with line numbers for all devices. All components shall be identified by a unique identification tag, terminal block numbers, wire sizes and color codes clearly identified, and external interconnections noted. Drawings shall be drawn in "landscape" mode.

(2) Provide complete terminal identification of all internal and external elements, panels, and junction boxes.

(3) Polarity of all analog signals shall be shown at each terminal as well as all shielded cable connections and grounding requirements.

(4) All external panel wiring that must be provided and installed shall be clearly identified as a dashed line. Use unique terminal symbols to denote MCC locations.

(5) All special cables that are provided with purchased equipment external to panels shall be identified as being supplied by the Supplier.

(6) Wiring diagrams shall show all circuits individually; no common diagrams will be allowed.

(7) Provide panel power wiring diagrams for all panels. The diagrams shall include all grounding requirements.

(d) Control Panel Submittal Format

(1) Tab 1. Index and Comments

(2) Tab "N" through "NN" as required:

- Heat Dissipation and Power Calculations Summary.
- Panel "A" Layout Drawing (one tab per panel).
- Panel "A" with Fabrication Drawing Legend/Engravings/Bill of Materials.
- Panel "A" Power Wiring.
- Panel "A" Wiring Diagrams.

(3) Tab "X" Loop Drawings (When Applicable).

(4) Tab "Y" Installation Details (When Applicable).

c. Analog Loop Drawing Submittal

i. Provide an individual loop wiring diagram for each analog loop showing all terminal numbers, the location of the DC power source, the location of any dropping resistors, polarity, etc. The loop diagrams shall meet the minimum requirements of ISA standard S5.4 approved 1992, plus the following requirements:

(a) Loop diagrams shall be on 11-inch by 17-inch paper. Only one loop shall be shown on each drawing.

(b) Reference to supplementary records and drawings, such as installation details, P&IDs, location drawings, wiring diagrams or drawings, and instrument specifications shall be included. Drawings may be included in the Control Panel Drawing Submittal when only a few drawings are required.

d. Instrument Installation Details Submittal

i. The Supplier shall develop and submit for review, complete installation details for each field mounted device and panel furnished prior to shipment and installation. Common details may be referenced by an index showing the complete instrument tag number, service, location, and device description. Installation details shall be provided as required to adequately define the installation of the components. Drawings may be included in the Control Panel Submittal when only a few are required.

e. Power Requirement and Heat Dissipation Summary

i. Provide a summary of the power requirements and heat dissipation for all control panels furnished. Power requirements shall state required voltages, currents, and phase(s). Heat dissipation shall be maximums and shall be given in BTU/Hr. Summary shall be supplemented with

calculations and show expected temperatures to be maintained for proper control equipment operation.

f. PLC Subsystem Submittal

i. In addition to the detailed hardware submittal requirements noted herein, the following shall also be provided:

(a) Theory of Operation and Logic Descrip tions.

(b) System block diagram and cabling re quirements.

(c) Annotated software program listing and I/O address mapping.
(d) I/O arrangement and wiring drawings.

g. Operation and Maintenance Manuals Submittal

i. Submit two (2) complete sets of Operation and Maintenance Instruction Manuals and Part Lists to the Owner for all equipment provided. Manuals shall be delivered no later than the equipment shipment date. After installation is complete, update the manuals to reflect any changes which occurred during installation and deliver the balance of the six (6) required manuals to the Owner.

ii. All manuals shall be original manufacturers literature provided as noted herein above.

iii. Include in the manuals not less than the following applicable information for each instrument, component, subsystem and/or control loop.

(a) Index and Comments

(1) Provide a detailed index identifying each tabbed section and its content.

(2) If there are any deviations or clarifications to the specifications, they shall be documented in writing in this section. If there are not comments or concerns identified in the submittal, it will be presumed that there are no deviations from the contract documents for the system being furnished.

(b) Bill of Materials

(1) A listing of all the panels, racks, instruments, components, and devices furnished. All components shall be grouped by component type, i.e., pressure switches, pressure gauges, indicators, etc. The list shall contain, as a minimum:

- Instrument, panel, rack or device tag number

- Description
- Quantity supplied
- Reference to component data sheet and/or catalog cut
- Component type

(c) Component Data Sheets

(1) Refer to 1.05-A, 4-(2) specified herein before.

(d) Catalog Cuts

(1) Refer to 1.05-A, 4-(3) specified herein before.

(e) Operation and Maintenance Manuals

(1) Operation and Maintenance manuals shall be submitted for all instruments and devices supplied. The O&M manuals shall contain, as a minimum:

- Operation procedures
- Installation procedures
- Maintenance procedures
- Troubleshooting procedures
- Calibration procedures
- Internal device schematics and wiring diagrams
- Shut-down procedures
- Component parts list
- Detailed circuit operational description including programmable controller ladder diagrams
- Listing of Manufacturers with local telephone numbers and contacts for all instrumentation hardware furnished.

(f) Spare Parts and Expendables List

(1) A spare parts and expendables list shall be submitted to include not only those items being supplied, but also any additional items recommended for successful long term operation.

(g) Operation and Maintenance Manual Format

(1) Volume I (or as required): Hardware

- Tab 1. Component Index and Comments
- Tab 2. Theory of Operation
- Tab "N" through "NN" as required:

- ❖ Component "X" Data Sheet(s) (one tab per component type as required).
- ❖ Standard Manufacturer Catalog Information, and Manufacturers O&M Manual

- Tab "X" Recommended Spare Parts and Expendables Listing

- Tab "Y" Current Manufacturers/ Local Representatives Telephone/ address listing for all major components.

(2) Volume II

- Tab 1. Index and Comments

- Tab "N" through "NN" as required:

  - ❖ Panel "X" Layout Drawing
  - ❖ Panel "X" Fabrication Drawing
  - ❖ Panel "X" Legend/ Engravings/Bill of Materials
  - ❖ Panel "X" Power Wiring
  - ❖ Panel "X" Wiring Diagrams

- Tab "X" Loop Drawings (When Applicable)

- Tab "Y" Installation Details (When Applicable)

h. System Calibration and Test Documentation Submittal

i. The Supplier shall submit an example of each type of Instrument Calibration Report and Loop Functional Test Report that will be used to verify that all preliminary calibration and testing has been performed and the system is considered, by the supplier, to be ready for the Owner's acceptance testing.

ii. After approval of the examples, the Supplier shall prepare Loop Functional Test Report(s) for each loop and an Instrument Calibration Sheet for each active element (except simple hand switches, lights, etc.). These sheets shall be completed and submitted to the Owner after completion of the operational availability field tests.

(a) Instrument Calibration Reports

(1) An Instrument Calibration report shall be used to certify that each instrument requiring calibration has been calibrated to its published specified accuracy shall be submitted to the Owner. This report shall include all applicable data as listed below plus an area to identify any defects noted, corrective action required, and corrections made.

- Facility identification (Name, location, etc.)

- Loop identification (Name or function)
- Equipment tag and serial numbers
- Scale ranges and units
- Test mode or type of test
- Input values or settings
- Expected outputs and tolerances
- Actual readings at 0, 10, 25, 50, 75, 90 and 100 percent of span
- Percent of error for each reading
- Explanations or special notes as applicable
- Date, time, and weather conditions
- Tester's certification with name and signature

(b) Loop and Functional Test Reports

(1) Submit a sample of each type of Loop and Functional Test Report form that will be used in verifying all control system functions as follows:

- Loop Status Report - For each function that can be demonstrated on a loop-by-loop basis:
  - ❖ Each form shall include:
    - ➢ Project name
    - ➢ Loop number
    - ➢ Loop description
    - ➢ Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.
    - ➢ For each component: tag number, description, manufacturer, and data sheet number.
    - ➢ Space for sign off and date by the Supplier

- Functional Acceptance Test Report - For those functions that cannot be demonstrated on a loop-by-loop basis:

  - ❖ Each form shall include a listing of the specific tests to be conducted. With each test description the following information shall be included:

    - ➢ Specification page and paragraph of function to be demonstrated.

    - ➢ Description of function.

    - ➢ Test procedure description.

    - ➢ Space after each specific test to facilitate sign off on completion of each test.

(c) Supplier's Installation Certification Reports

(1) Upon completion of all preliminary calibration and functional testing, the Supplier, shall submit a certified report for each control panel and its associated field instruments certifying that the equipment (1) had been properly installed under his or her supervision, (2) is in accurate calibration, (3) was placed in operation, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactorily, and (6) is fully covered under the terms of the guarantee.

i. Functional Acceptance Test Procedures Submittal

i. Submit for approval not later than 30 days prior to the functional acceptance test demonstration, a written plan for demonstrating that each device and function including all alarms of the equipment provided under these specifications meets the specified operational requirements.

ii. The plan shall detail procedures to be used in the functional acceptance testing of all systems. The plan shall include a description of test methods and materials that will be utilized for testing each system.

iii. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing.

F. SYSTEM TESTING AND ACCEPTANCE

1. Installation Supervision

Furnish the services of authorized factory personnel specially trained and experienced in the installation of the equipment to: (1) supervise the installation in accordance with the approved Instruction Manuals; (2) be present when the instruments and equipment are first delivered, installed, and put into operation; (3) inspect, check, adjust as necessary,

and approve the installation; (4) calibrate the instruments, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable. (5) coordinate all field control wiring furnished by others related to the Instrumentation, Control and Monitoring System. Direct the Contractor on where to land all related control wire.

2. Preliminary Calibration and Functional Testing

a. After approval of the Loop Status Report and Calibration Worksheets described herein, the Supplier shall prepare Loop Status Report(s) for each loop and an Instrument Calibration Worksheet for each active element (except simple hand switches, lights, etc.). These sheets shall be completed, signed, and submitted to the Owner after the Preliminary Calibration and Functional Testing is completed.

b. Although the Preliminary Calibration and Functional Testing does not require witnessing, the equipment Supplier shall maintain the reports and calibration worksheets at the job-site and make them available for the Owner's review at any time.

i. Preliminary Calibration

(a) Provide the services of factory trained instrumentation technician, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration.

ii. Functional Testing

(a) Provide Loop Status Report(s) for verifying all control system functions as follows:

(1) Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance. System tolerance is defined as the root-mean-square sum of the system components specified accuracy's from input to output.

(2) Validate calibration of each system by simulating inputs at the first element in the loop (i.e., sensor) of zero, 10, 25, 50, 75, 90 and 100 percent of span, or on/off and verify loop output devices (i.e., recorder, indicator, alarm, etc. except controllers). During system validation, make provisional settings on levels, alarms, etc. Verify that all logic sequences operate in accordance with the specifications.

(3) Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation.

(4) Immediately correct all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.

iii. Supplier's Certified Reports

(a) Upon completion of the Preliminary Calbration and Functional Testing, the Supplier shall submit a certified report for each control panel and associated field instruments certifying that the equipment (1) had been properly installed under his supervision, (2) is in accurate calibration, (3) was placed in operation, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactory.

3. Functional Demonstration Testing

a. Upon completion of the Preliminary Calibration and Functional Testing, re-test all systems in the presence of the Owner (or representative). The intent of this test is to demonstrate and verify the operational interrelationship of all instrumentation systems. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or actual) to verify all alarms, failure interlocks, and operational interlocks between systems and/or mechanical equipment. Notify the Owner in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon successful completion of this test the Supplier shall begin the Operational Acceptance Test Demonstration.

4. Operational Acceptance Test Demonstration

a. Upon completion of the Functional Demonstration Testing, re-test all systems under actual process conditions in the presence of the Owner and the Owner's Operators. The intent of this test is to demonstrate and verify the operational interrelationship of all instrumentation systems to the Owner's Operators. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or actual) to verify all alarms, failure interlocks, operational interlocks between systems and/or mechanical equipment, and making final adjustments. Notify the Owner in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon successful completion of this test the Supplier shall begin the 30 Day Availability Test.

5. 30 Day Availability Test

a. After completion of the Operational Acceptance Test Demonstration, the System Supplier shall be responsible for the operation of the supplied system for a period of 30 consecutive days, under conditions of full process operation, without a single non-field repairable malfunction.

b. During this test, plant operating and supplier personnel shall be present as required. While the test is proceeding, the Owner shall have full use of the system.

c. If any failures should occur that cannot be corrected within 24 hours, or more than two similar failures of any duration, the failure will be considered as a non-

field-repairable malfunction. The system shall be repaired and the 30 day test period shall be re-started. Owner reserves the right to set the schedule.

d. Total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as "Availability = (Total Down Time) ÷ (Total Time)".

e. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided, shall not contribute to the availability test times above.

f. Upon successful completion of the system availability testing, submit a certified report, with substantiating data sheets, indicating that the equipment furnished meets all the functional requirements specified herein. The Owners will countersign this report and it shall constitute acceptance of the control system hardware.

G. FINAL DOCUMENTATION

1. Reproducible Drawings

a. The Supplier shall submit one (1) set of full size reproducible of complete schematics, wiring diagrams and installation drawings to include all installed field and panel instruments, mounting details, point-to-point diagrams with cable, wire, and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled "As-Installed". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.

i. Loop Diagrams

ii. Panel Construction Drawings and Wiring Diagrams

iii. Interconnecting Wiring Diagrams

iv. Instrument Installation Details

2. Software

a. In addition to the reproducible hard copy of drawings and literature specifically generated for the project, one (1) set of 3.5 inch, 1.44 MEG capacity diskettes shall be submitted to the Owner which shall include a copy of all files specifically generated to create the drawings, data sheets, bill of materials, operating and test procedures, control logic, etc. Diskettes shall be clearly labeled with the following:

i. Project Name

ii. Volume Number

iii. Software Program Name and Version used to generate the files

iv. Label "As-Installed"

b. Special devices used in programming supplied hardware shall be provided. It is the intent that the Owner shall have the full capability to re-program and modify any application on-site without the need to purchase additional hardware.

3. Operation and Maintenance Manuals

a. Furnish the balance of six (6) sets of Operation and Maintenance Manuals for equipment provided under these Specifications. Content shall be as described above for the submittals.

H. TRAINING REQUIREMENTS

1. General

a. Provide the services of a factory trained and field experienced control systems engineer to conduct group training of Owner's designated personnel in the operation of all Instrumentation, Control and Monitoring equipment furnished. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands-on" operation. The text for this training shall be the P&IDs, panel wiring diagrams, layouts, ladder listings, and the operation and maintenance manuals furnished under these Specifications.

2. Duration

Training specific to the system hardware shall be provided for a minimum of three operating shifts with a time period necessary to cover complete Operator and Maintenance Training.

3. Operator Training

a. Operator training shall include instruction in the use of all control system hardware and software furnished. A detailed written description of the system furnished and all equipment start-up, shut-down, troubleshooting, and maintenance procedures shall be provided to each Operator attending the training sessions. Training material shall be organized and bound in appropriate binders. One copy of the training manual shall be submitted to the Owner prior to scheduling any training sessions. As a minimum, the format for the training material shall be as follows:

i. General system description and overview

ii. Process and Instrumentation Diagrams

iii. Sequence of Operation

(a) Panel Layout Drawing
(b) Legend
(c) Alarm Handling
(d) System Start-Up
(e) System Shut-Down
(f) Operator Adjustment & Setpoints

iv. General Troubleshooting Techniques

v. Recommended Maintenance Procedures

vi. Recommended Spare Parts

4. Maintenance Training

a. Maintenance training shall include instruction in the calibration, maintenance, programming, and repair for all systems furnished.

b. Maintenance training shall include instruction in the maintenance of all control system hardware and software furnished. A detailed written description of the system furnished and all equipment start-up, shut-down, troubleshooting, and maintenance procedures shall be provided to each person attending the training sessions. Training material shall be organized and bound in appropriate binders. One copy of the training manual shall be submitted to the Owner prior to scheduling any training sessions. As a minimum, the format for the training material shall be as follows:

i. General system description and overview

ii. Process and Instrumentation Diagrams

iii. Sequence of Operation

(a) Panel Layout Drawing
(b) Legend
(c) Alarm Handling
(d) System Start-Up
(e) System Shut-Down
(f) Operator Adjustment & Setpoints

iv. Detailed review of all schematic diagrams

v. Detailed review of all software functions using actual software listings

vi. Detailed programming instruction of hardware furnished unless otherwise noted

vii. Detailed calibration procedures for all furnished

viii. Recommended Maintenance Procedures

ix. Recommended Spare Parts

5. Final Acceptance

Final Owner acceptance is defined as a point in time when (1) all training has been performed, (2) final "As Installed" documentation and software (when applicable) have been received and approved, (3) the system has successfully passed the availability test period, and (4) all punch list items have been resolved. Only at this time, will final payment be released.

6. Guarantee And Warrantees

a. Guarantee all work of these Specifications for a period of one (1) year from the date of final acceptance by the Owner. With respect to instruments and equipment, guarantee shall cover (a) faulty or inadequate design; (b) improper assembly or erection; (c) defective workmanship or materials; and (d) leakage, breakage, or other failure not caused by Owner misuse. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to Owner with Owner named as beneficiary.

PART 2 - PRODUCTS

A. JOB CONDITIONS

1. Exercise care (1) to secure neat arrangement of all piping, valves, conduit, and like items, and (2) to overcome structural interference's. Verify dimensions and conditions at the place of work, and install materials and equipment in the available spaces.

B. MATERIALS AND STANDARD SPECIFICATIONS

1. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as Instrument Society of America (ISA). The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the facilities; i.e., all instruments furnished by the Supplier of the same type of function shall be by the same manufacturer. This allows the stocking of the minimum number of spare parts.

C. PRODUCT DELIVERY, STORAGE, AND HANDLING

Box, crate or otherwise enclose and protect instruments and equipment during shipment, handling and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids, and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

D. MOUNTING

1. Mount and install equipment as required. Mount field instruments according to the best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with manufacturers recommendations.

2. Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting. Non in-line indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than three (3) feet nor high than five (5) feet above walkways, platforms, catwalks, etc. All such equipment shall be weather and splash proof, and electrical equipment shall be in NEMA 4X cases unless otherwise noted.

E. COMPONENT TAG NUMBERING SCHEME

1. All control equipment shall be identified by unique alphanumeric code or tag number based on the latest Instrument Society of America standards S5.1.

2. Tag Numbering Scheme: a-b-c-d

3. Equipment tagging shall be based on the following scheme:

	Description	TAG	Explanation
a.	ISA Functional Identification	HS	Hand Switch
b.	Loop Number	23	Loop 23
c.	Component Number	2	Second HS in Loop
d.	PLC ID Number	10007	Seventh Input to PLC

Example 1: HS-23-2-10007

Tag number identifies a Hand Selector Switch. It is part of Loop 23 and the second hand selector switch in the loop. It is the seventh input to the PLC. It is also the only hand selector switch in the loop.

Example 2: HS-23-1007

Tag number identifies a Hand Selector Switch in Loop 23. It is also the only hand selector switch in the loop. It is the seventh input to the PLC.

F. INSTRUMENT IDENTIFICATION

1. All components provided, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire tag number of the component. Panel mounted tags shall be white with black lettering lamicoid plastic; field mounted tags shall be stamped stainless steel.

2. Nameplates for panels and panel mounted equipment shall be as indicated on the Drawings.

3. Field mounted tags shall be 16-gauge, 304 stainless steel with 3/16 inch high characters.

4. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard stainless steel hose clamps and meeting the same description. In some cases where this would be impractical, use 20 gauge stainless steel wire.

5. For field panels or large equipment cases use stainless steel screws, however, such permanent attachment shall not be on an ordinarily replaceable part. In all cases, the tag shall be plainly visible to a standing observer and not obscure adjustment ports or impair the function of the instrument. Field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed. Nameplate shall be attached by one of the above methods.

G. STANDARD LIGHT COLORS AND INSCRIPTIONS

Unless otherwise noted, the following color code and inscriptions shall be followed:

Tag Function	Inscription(s)	Color
ON	ON	RED
OFF	OFF	GREEN

OPEN	OPEN	RED
CLOSED	CLOSED	GREEN
LOW	LOW	RED
FAIL	FAIL	RED
HIGH	HIGH	RED
AUTO	AUTO	WHITE
MANUAL	MANUAL	YELLOW
LOCAL	LOCAL	WHITE
REMOTE	REMOTE	AMBER

Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.

H. STANDARD PUSHBUTTON COLORS AND INSCRIPTIONS

Tag Function	Inscription(s)	Color
OO	ON	RED
	OFF	GREEN
OC	OPEN	GREEN
	CLOSED	RED
OCA	OPEN	GREEN
	CLOSED	RED
	AUTO	WHITE
OOA	ON	GREEN
	OFF	RED
	AUTO	WHITE
MA	MANUAL	YELLOW
	AUTO	WHITE
SS	START	GREEN
	STOP	RED
RESET	RESET	RED

All unused or non inscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red, and

I. ELECTRONIC EQUIPMENT

If the equipment is electronic in nature, provide industrial duty, solid state equipment to the greatest extent practicable. Select components of construction for their suitability and reliability. Employ adequate component de-rating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Where conduit connection is provided for mounting a surge/lightning suppressor directly to the instrument, the arrestor shall be so mounted.

J. EQUIPMENT OPERATING CONDITIONS

1. All equipment shall be rated for normal operating performance with varying operating conditions over the following ranges:

   a. Power:

      120 Vac ±10%, 60 Hz ±1 Hz except where specifically stated otherwise on the drawings or in the specifications.

   b. Environmental Conditions:

      i. Equipment rated NEMA 1 or NEMA 12 shall be suitable for the following environmental conditions:

         (a) Temperature: 40 to 105 degrees F.
         (b) Relative Humidity: 10 to 80 percent.
         (c) Classification: Non-hazardous.

2. Equipment rated NEMA 4X shall be suitable for the following environmental conditions:

   a. Temperature: 20 to 105 degrees F.

   b. Relative Humidity: 10 to 100 percent.

   c. Classification: Non-hazardous.

   d. Atmosphere: Corrosive.

K. SIGNAL ISOLATORS, CONVERTERS AND CONDITIONERS

1. Insure that input-output of all instruments and control devices (whether furnished by the Supplier or not) are compatible. Analog signals between field and panels shall be 4 to 20 mA dc unless specifically approved otherwise. Granting such approval does not relieve the Supplier from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application, as required for accurate signal acquisition.

L. AUXILIARY CONTACTS BY OTHERS

1. Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

M. ELECTRICAL

1. The construction work shall include all power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified, and required.

2. Wiring installations shall include cables, conductors, terminals, connectors, heat shrunk wire markers on all terminations, conduits, conduit fittings, supports, hardware, and all other required materials.

3. Provide the materials and complete all the required installations for equipment grounding.

4. Incidental items not specifically included in the Contract Documents that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided and installed by the Supplier at no additional cost to the Owner.

5. Ring out all signal wiring prior to termination. Provide wire number tags marked in indelible waterproof form of slip-on type and heat shrunk for each wire termination point in the panel and field. Wire tagging shall identify the destination point of the wire and when applicable, shall include the signal polarity for analog signals. Each destination point shall be coded as follows:

    i. Destination ID - Terminal Block ID - Terminal Number - (Polarity)

N. ELECTRICAL TRANSIENT PROTECTION

1. All instrument and control equipment mounted outside of protective structures (field mounted equipment) shall be equipped with suitable surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Both power and signal circuits shall be protected with surge and transient protectors installed at the source and destination ends of the circuits. Protective devices used on 120V ac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of IEEE Standard 28-1972 (ANSI C62.1-1971).

2. Surge and transient protectors shall be normally connected to the electrical system ground. When an electrical system ground is not available near the device, the protectors shall be connected to a ground rod 10 ft. in length by 3/4 inch in diameter and located within 10 feet of the device.

3. Protectors for signal circuits at the field transmitter and in panels shall be EDCO PC 642-30 WITH PCBIB BASE in panels. Protectors for 120 volt power circuits shall be UL listed Joslyn Model No. 1250-32 secondary arrestor.

O. PROCESS CONNECTIONS

1. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance, etc. All instrument pneumatic tubing shall be stainless steel with stainless steel fittings. Slope lines according to service to promote self draining or venting back to the process. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shut down of the process. Include drip legs and blow-down valves for terminations of sense lines at the instruments when mounted such that condensation can accumulate.

P. MISCELLANEOUS MECHANICAL

1. Three Valve Instrument Equalizing Manifold

    a. Manifolds shall be of stainless steel construction for isolation and equalization of differential pressure transducers. Units shall be Anderson, Greenwood and Company Type M1 or Equivalent.

Q. PAINTING

Provide factory paint for all instruments and equipment. Provide paint as required for non-stainless steel structural supports, brackets, etc.

R. CORROSION PROTECTION

All control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, the capsules shall be provided within the shipping containers and equipment as recommended by the capsule manufacturer's recommendations. All capsules shall be replaced by the Contractor just prior to Owner's final acceptance of the equipment. The corrosion-inhibiting vapor capsules shall be Northern Instruments Model Zerust VC or Hoffman Model A-HCI. NEMA 4x panels shall be provided with breather/drains, Crouse-Hinds Model ECD18; or approved equal.

S. SPARES AND MAINTENANCE MATERIALS

1. Deliver to Owner, as directed, the following items as specified herein. Include an itemized list in a letter of transmittal with each shipment.

2. Materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.

    a. One fuse of each size and type for every five used but no less than five of each type.

    b. One circuit breaker of each size and type for every five used but no less than one of each type.

    c. One relay of each type for every five used but no less than one of each type.

    d. One status light bulb for every five used but no less than five of each type.

    e. One indicating lamp assembly for every five panel mounted lamp assemblies used but no less than one of each type.

    f. One switch assembly for every five used but no less than one of each type.

    g. One transient protector for every five used but no less than one of each type.

T. WORKMANSHIP

1. General

    a. Install materials and equipment in a workmanlike manner utilizing craftsman skilled in the particular trade. Provide work which has a neat and finished appearance.

    b. Coordinate work with the Owner, and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the facilities during construction.

2. Protection During Construction

a. Throughout this Contract, the Contractor shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the Owner reviewed Contractor recommendations.

3. Material and Equipment Installation

a. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instructions, and these Contract Documents, follow the Owners decision, at no additional cost to the Owner. Keep copy of manufacturers' installation instructions on the job site available for review at all times.

4. Removal or Relocation of Materials and Equipment

Where existing materials and equipment are removed or relocated, remove and deliver to the Owner all materials no longer used unless otherwise directed by the Owner. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Follow any specific instructions by the Owner.

5. Cleaning and Touchup Painting

Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of panels and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

6. Panels and Panel-Mounted Equipment

Panels and panel-mounted equipment shall be assembled as far as possible at the factory. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the job site.

7. Electrical

a. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for any wire bundles which pass through holes or across edges of sheet metal.

b. Wiring shall not be spliced or taped except at the device terminals or terminal blocks.

c. Use manufacturer's recommended tool with the proper sized anvil, for all crimp terminations. No more than one wire may be terminated in a single crimp lug and no more than two lugs may be installed on a single screw terminal.

8. Inspections

All materials, equipment, and workmanship shall be subject to inspection at any time by the Owner. Correct any work, materials, or equipment not in accordance with these

Contract Documents or found to be deficient or defective in a manner satisfactory to the Owner at no additional cost to the Owner.

END OF SECTION

TABLE 16915-1
I/O SCHEDULE

Description	ISA Tag	Type	Signal	Range/ N.O. Status	Units/ N.C. Status	Field Wiring			Specification Section Responsible for Signal Source	Remarks
						ISA Signal Source Design.	Signal Source Device	PLC Panel		
MCP Loss of Normal Power	JUR-001	DI	Form C	Normal	Alarm	JS-001	BPCP	BPCP	16915	EVT
MCP Loss of UPS Power	JUR-002	DI	Form C	Normal	Alarm	JS-002	BPCP	BPCP	16915	EVT
MCP Loss of DC Power #1	JUR-003	DI	Form C	Normal	Alarm	JS-003	BPCP	BPCP	16915	EVT
MCP Loss of DC Power #2	JUR-004	DI	Form C	Normal	Alarm	JS-004	BPCP	BPCP	16915	EVT
By-Pass In Normal	JUR-005	DI	Form C	Normal	Alarm	JS-004	BPCP	BPCP	16915	EVT
Control Valves										
CV-2 Open	ZIO-202	DI	Form C	Normal	Open	ZSO-202	CV-2	BPCP	16915	EVT, EFD
CV-2 Closed	ZIC-202	DI	Form C	Normal	Closed	ZSC-202	CV-2	BPCP	16915	EVT, EFD
CV-2 Open Command	YC-202	DI	Form C	Open	Close	YR-202	BPCP	BPCP	16915	EVT
CV-3 Open	ZIO-203	DI	Form C	Normal	Open	ZSO-203	CV-2	BPCP	16915	EVT, EFD
CV-3 Closed	ZIC-203	DI	Form C	Normal	Closed	ZSC-203	CV-2	BPCP	16915	EVT, EFD
CV-3 Open Command	YC-203	DI	Form C	Open	Close	YR-203	BPCP	BPCP	16915	EVT
CV-6 Cocoa Flow Setpoint	FC-101	AO	4-20mA	0-3100	gpm	FR-101	BPCP	BPCP	16915	EVT
CV-6 Cocoa Flow	FIQR-101	AI	4-20mA	0-3100	gpm/MGD	FT-101	FIT-101	CV-6	SHT 5	EVT
CV-7 Titusville Flow	FIQR-102	AI	4-20mA	0-7000	gpm/MGD	FT-102	FIT-102	CV-7	SHT 5	EVT
CV-7 Titusville Flow Setpoint	FC-102	AO	4-20mA	0-7000	gpm	FR-102	BPCP	BPCP	16915	EVT
Ground Storage Tank										
Tank Level	LIR-200	AI	4-20mA	0-37	FT.IN	LIT-200	LIT-200	BPCP	16915	MX, MN, MA, HH, LL, EFD
Tank Emergency High	LAHH-200	DI	Form C	Normal	Alarm	LSH-200	LSH-200	BPCP	16915	EVT, EFD
Tank Emergency Low	LALL-200	DI	Form C	Normal	Alarm	LSL-200	LSL-200	BPCP	16915	EVT, EFD
Mixer #1 Run Status	YQIR-201	DI	Form C	Stopped	Running	YS-201	MCC	BPCP	16915	EVT,CRT,DRT,DSC,EFD
Mixer #1 In Remote	ZIR-201A	DI	Form C	Normal	Remote	ZS-201A	MCC	BPCP	16915	EVT, EFD
Mixer #1 In Auto	ZIR-201B	DI	Form C	Normal	Remote	ZS-201B	HOA	BPCP	16915	EVT, EFD
Mixer #1 Overload	JAR-201	DI	Form C	Normal	Alarm	JS-201	MCC	BPCP	16915	EVT, EFD
Mixer #1 Motor High Temp.	TAR-201	DI	Form C	Normal	Alarm	TS-201	MCC	BPCP	16915	EVT, EFD
Mixer #1 Run Command	YC-201	DO	Form C	Stop	Start	YR-201	BPCP	BPCP	16915	EFD
High Service Pumping										
HSP Pump #1 Run Status	YQIR-301	DI	Form C	Stopped	Running	YS-301	VFD	BPCP	16370	EVT,CRT,DRT,DSC
HSP Pump #1 VFD Fail	EUIR-301	DI	Form C	Normal	Alarm	ES-301	VFD	BPCP	16370	EVT
HSP Pump #1 No Flow	FAIR-301	DI	Form C	Normal	Alarm	FS-301	FS-301	BPCP	16915	EVT
HSP Pump #1 VFD In Manual	ZIR-301A	DI	Form C	Normal	Auto	ZS-301A	VFD	BPCP	16370	EVT
HSP Pump #1 VFD In Remote	ZIR-301C	DI	Form C	Normal	Remote	ZS-301C	VFD	BPCP	16370	EVT
HSP Pump #1 Motor High Temp	TAR-301	DI	Form C	Normal	Alarm	TS-301	VFD	BPCP	16370	EVT
HSP Pump #1 Motor High Vibration	VAR-301	DI	Form C	Normal	Alarm	VS-301	VS-301	BPCP	16915	EVT
HSP Pump #1 Speed Feedback	ZIR-301	AI	4-20mA	0-100%	%	ZR-301	VFD	BPCP	16370	MN, MX,
HSP Pump #1 Speed Command	SC-301	AO	4-20mA	0-100%	%	ST-301	BPCP	BPCP	16915	
HSP Pump #1 Run Command	YC-301	DO	Form C	Stop	Start	YR-301	BPCP	BPCP	16915	
HSP Pump #2 Run Status	YQIR-302	DI	Form C	Stopped	Running	YS-302	VFD	BPCP	16370	EVT,CRT,DRT,DSC
HSP Pump #2 VFD Fail	EUIR-302	DI	Form C	Normal	Alarm	ES-302	VFD	BPCP	16370	EVT

TABLE 16915-1
I/O SCHEDULE

Description	ISA Tag	Type	Signal	Range/ N.O. Status	Units/ N.C. Status	Field Wiring			Specification Section Responsible for Signal Source	Remarks
						ISA Signal Source Design.	Signal Source Device	PLC Panel		
HSP Pump #2 No Flow	FAIR-302	DI	Form C	Normal	Alarm	FS-302	FS-302	BPCP	16915	EVT
HSP Pump #2 VFD In Manual	ZIR-302A	DI	Form C	Normal	Auto	ZS-302A	VFD	BPCP	16370	EVT
HSP Pump #2 VFD In Remote	ZIR-302C	DI	Form C	Normal	Remote	ZS-302C	VFD	BPCP	16370	EVT
HSP Pump #2 Motor High Temp	TAR-302	DI	Form C	Normal	Alarm	TS-302	VFD	BPCP	16370	EVT
HSP Pump #2 Motor High Vibration	VAR-302	DI	Form C	Normal	Alarm	VS-302	VS-302	BPCP	16915	EVT
HSP Pump #2 Speed Feedback	ZIR-302	AI	4-20mA	0-100%	%	ZR-302	VFD	BPCP	16370	MN, MX,
HSP Pump #2 Speed Command	SC-302	AO	4-20mA	0-100%	%	ST-302	BPCP	BPCP	16915	
HSP Pump #2 Run Command	YC-302	DO	Form C	Stop	Start	YR-302	BPCP	BPCP	16915	
HSP Pump #3 Run Status	YQIR-303	DI	Form C	Stopped	Running	YS-303	VFD	BPCP	16370	EVT,CRT,DRT,DSC
HSP Pump #3 VFD Fail	EUIR-303	DI	Form C	Normal	Alarm	ES-303	VFD	BPCP	16370	EVT
HSP Pump #3 No Flow	FAIR-303	DI	Form C	Normal	Alarm	FS-303	FS-303	BPCP	16915	EVT
HSP Pump #3 VFD In Manual	ZIR-303A	DI	Form C	Normal	Auto	ZS-303A	VFD	BPCP	16370	EVT
HSP Pump #3 VFD In Remote	ZIR-303C	DI	Form C	Normal	Remote	ZS-303C	VFD	BPCP	16370	EVT
HSP Pump #3 Motor High Temp	TAR-303	DI	Form C	Normal	Alarm	TS-303	VFD	BPCP	16370	EVT
HSP Pump #3 Motor High Vibration	VAR-303	DI	Form C	Normal	Alarm	VS-303	VS-303	BPCP	16915	EVT
HSP Pump #3 Speed Feedback	ZIR-303	AI	4-20mA	0-100%	%	ZR-303	VFD	BPCP	16370	MN, MX,
HSP Pump #3 Speed Command	SC-303	AO	4-20mA	0-100%	%	ST-303	BPCP	BPCP	16915	
HSP Pump #3 Run Command	YC-303	DO	Form C	Stop	Start	YR-303	BPCP	BPCP	16915	
PT-3 Distrbution Pressure	PIR-201	AI	4-20mA	0-100	psi	PIT-201	PIT-201	BPCP	16915	MX, MN, MA, HH, LL
PT-4 Distrbution Pressure (Backup)	PIR-202	AI	4-20mA	0-100	psi	PIT-202	PIT-202	BPCP	16915	MX, MN, MA, HH, LL
PT-2 Suction Pressure	PIR-200	AI	4-20mA	0-60	psi	PIT-200	PIT-200	BPCP	16915	MX, MN, MA, HH, LL, EFD
Distribution Flow	FIQR-202	AI	4-20mA	0-5300	psi	FIT-202	FIT-202	BPCP	16915	MX, MN, MA, HH, LL
Chemicals										
CL2 Sample Pump Run Status	YQIR-501	DI	Form C	Stopped	Running	YS-501	MCC	BPCP	16915	EVT,CRT,DRT,DSC,EFD
CL2 Sample Pump Run Command	YC-501	DO	Form C	Stop	Start	YR-501	AACP	BPCP	16915	
CL2 Analyzer #1	AIR-200	AI	4-20mA	0-10	ppm	AIT-200	AIT-200	BPCP	16915	MX, MN, MA, HH, LL
CL2 Analyzer #2	AIR-200	AI	4-20mA	0-10	ppm	AIT-200	AIT-200	BPCP	16915	MX, MN, MA, HH, LL
Sample Control Solenoid #1	YC-200	DO	Form C	Open	Close	YR-200	SV-200	BPCP	16915	Provide 120VAC power
Sample Control Solenoid #2	YC-101	DO	Form C	Open	Close	YR-101	SV-101	BPCP	16915	Provide 120VAC power
Sample Control Solenoid #3	YC-102	DO	Form C	Open	Close	YR-102	SV-102	BPCP	16915	Provide 120VAC power
AA Metering Pump #1 Run Status	YQIR-601	DI	Form C	Stopped	Running	YS-601	AACP	BPCP		EVT,CRT,DRT,DSC
AA Metering Pump #1 Fail Status	YAR-601	DI	Form C	Normal	Alarm	YS-601A	AACP	BPCP		EVT
AA Metering Pump #1 Run Command	YC-601	DO	Form C	Stop	Start	YR-601	AACP	BPCP	16915	
AA Metering Pump #1 Speed Command	SC-601	AO	4-20mA	0-100%	%	ST-601	AACP	BPCP	16915	
AA Metering Pump #2 Run Status	YQIR-602	DI	Form C	Stopped	Running	YS-602	AACP	BPCP		EVT,CRT,DRT,DSC
AA Metering Pump #2 Fail Status	YAR-602	DI	Form C	Normal	Alarm	YS-602A	AACP	BPCP		EVT
AA Metering Pump #2 Run Command	YC-602	DO	Form C	Stop	Start	YR-602	AACP	BPCP	16915	
AA Metering Pump #2 Speed Command	SC-602	AO	4-20mA	0-100%	%	ST-602	AACP	BPCP	16915	
CS Metering Pump #1 Run Status	YQIR-701	DI	Form C	Stopped	Running	YS-701	CSCP	BPCP		EVT,CRT,DRT,DSC
CS Metering Pump #1 Fail Status	YAR-701	DI	Form C	Normal	Alarm	YS-701A	CSCP	BPCP		EVT
CS Metering Pump #1 Run Command	YC-701	DO	Form C	Stop	Start	YR-701	CSCP	BPCP	16915	
CS Metering Pump #1 Speed Command	SC-701	AO	4-20mA	0-100%	%	ST-701	CSCP	BPCP	16915	

TABLE 16915-1
I/O SCHEDULE

Description	ISA Tag	Type	Signal	Range/ N.O. Status	Units/ N.C. Status	Field Wiring			Specification Section Responsible for Signal Source	Remarks
						ISA Signal Source Design.	Signal Source Device	PLC Panel		
CS Metering Pump #2 Run Status	YQIR-702	DI	Form C	Stopped	Running	YS-702	CSCP	BPCP		EVT,CRT,DRT,DSC
CS Metering Pump #2 Fail Status	YAR-702	DI	Form C	Normal	Alarm	YS-702A	CSCP	BPCP		EVT
CS Metering Pump #2 Run Command	YC-702	DO	Form C	Stop	Start	YR-702	CSCP	BPCP	16915	
CS Metering Pump #2 Speed Command	SC-601	AO	4-20mA	0-100%	%	ST-601	CSCP	BPCP	16915	
Booster Pumping										
BP#1 Run Status	YQIR-401	DI	Form C	Stopped	Running	YS-401	VFD	BPCP	16915	EVT,CRT,DRT,DSC,EFD
BP#1 No Flow	FAIR-401	DI	Form C	Normal	Alarm	FS-401	FS-401	BPCP	16915	EVT
BP#1 In Remote Mode	ZIR-401C	DI	Form C	Normal	Remote	ZS-401C	VFD	BPCP	16915	EVT
BP#1 High Vibration	VAR-401	DI	Form C	Normal	Alarm	VS-401	VS-401	BPCP	16915	EVT
BP#1 VFD Trouble	EUIR- 401	DI	Form C	Normal	Alarm	ES-401	VFD	BPCP	16915	EVT
BP#1 Motor High Temp	TAR-401	DI	Form C	Normal	Alarm	TS-401	VFD	BPCP	16915	EVT
BP#1 In By-pass	ZIR-401B	DI	Form C	Normal	Remote	ZS-401B	VFD	BPCP	16915	EVT
BP#1 Run Command	YC-401A	DO	Form C	Stop	Start	YR-401A	BPCP	BPCP	16915	
BP#1 Speed Command	SC-401	AO	4-20mA	0-100%	%	ST-401	BPCP	BPCP	16915	
BP#1 By-pass Run Command	YC-401B	DO	Form C	Stop	Start	YR-401B	BPCP	BPCP	16915	
BP#2 Run Status	YQIR-402	DI	Form C	Stopped	Running	YS-402	VFD	BPCP	16915	EVT,CRT,DRT,DSC,EFD
BP#2 No Flow	FAIR-402	DI	Form C	Normal	Alarm	FS-402	FS-402	BPCP	16915	EVT
BP#2 In Remote Mode	ZIR-402C	DI	Form C	Normal	Remote	ZS-402C	VFD	BPCP	16915	EVT
BP#2 High Vibration	VAR-402	DI	Form C	Normal	Alarm	VS-402	VS-402	BPCP	16915	EVT
BP#2 VFD Trouble	EUIR- 401	DI	Form C	Normal	Alarm	ES-402	VFD	BPCP	16915	EVT
BP#2 Motor High Temp	TAR-402	DI	Form C	Normal	Alarm	TS-402	VFD	BPCP	16915	EVT
BP#2 In By-pass	ZIR-402B	DI	Form C	Normal	Remote	ZS-402B	VFD	BPCP	16915	EVT
BP#2 Run Command	YC-402A	DO	Form C	Stop	Start	YR-402A	BPCP	BPCP	16915	
BP#2 By-pass Run Command	SC-402	AO	4-20mA	0-100%	%	ST-402	BPCP	BPCP	16915	
	YC-402B	DO	Form C	Stop	Start	YR-402B	BPCP	BPCP	16915	
Miscellaneous										
Em. Shower In Use	YA-900	DI	Form C	Normal	Alarm	YS-900	LCP	BPCP	16915	EVT
Em. Shower Reset	ZI-900	DI	Form C	Normal	Reset	ZS-900	LCP	BPCP	16915	EVT
Fuel Tank High Level	LAH-800	DI	Form C	Normal	Alarm	LSH-800	LCP	BPCP	16915	
Fuel Tank Low Level	LAL-800	DI	Form C	Normal	Alarm	LSL-800	LCP	BPCP	16915	
Fuel Tank Leak	YA-800A	DI	Form C	Normal	Alarm	YS-800A	LCP	BPCP	16915	
Generator Room Fuel Leak	YA-800B	DI	Form C	Normal	Alarm	YS-800B	LCP	BPCP	16915	
Generator Day Tank High	LAH-800A	DI	Form C	Normal	Alarm	LSH-800A	LCP	BPCP	16915	
Generator Day Tank Low	LAL-800A	DI	Form C	Normal	Alarm	LSL-800A	LCP	BPCP	16915	
Battery Charger Trouble	EA-800	DI	Form C	Normal	Alarm	ES-800	LCP	BPCP	16915	
ATS Position	ZI-800								16915	
Office Intrution	YI-901	DI	Form C	Normal	Alarm	YS-901	DS	BPCP	16915	
Generator Room Intrution	YI-902	DI	Form C	Normal	Alarm	YS-902	DS	BPCP	16915	
Ammonia Room Intrution	YI-903	DI	Form C	Normal	Alarm	YS-903	DS	BPCP	16915	
CL2 Room Intrution	YI-904	DI	Form C	Normal	Alarm	YS-904	DS	BPCP	16915	
Pump Room Intrution	YI-905	DI	Form C	Normal	Alarm	YS-905	DS	BPCP	16915	
EF-1 Run Status	YQIR-810	DI	Form C	Stopped	Running	YS-810	MCC	BPCP	16915	EVT,CRT,DRT,DSC,EFD
EF-2 Run Status	YQIR-811	DI	Form C	Stopped	Running	YS-811	MCC	BPCP	16915	
Pump Room High Temp.	TA-810	DI	Form C	Normal	Alarm	TS-810	T-STAT	BPCP	16915	

TABLE 16915-1
I/O SCHEDULE

Description	ISA Tag	Type	Signal	Range/ N.O. Status	Units/ N.C. Status	Field Wiring			Specification Section Responsible for Signal Source	Remarks
						ISA Signal Source Design.	Signal Source Device	PLC Panel		

* All Discrete Input Contacts shall be powered from input location

Provide 20% Spare I/O of each type including programming typical status or alarm for all DI, process indication, trending and historical database for typical AI, and typical interlocking for DO, plus retransmit for spare AO.

Abbreviations:

MCC	Motor Control Center	MX	Daily Maximum	LCP	Local Control Panel
MA	Daily Average	MN	Daily Minimum	GFI	120V Ground Fault Circuit
DT	Daily Flow Total	HH	High Limit Alarm	PMR	Panel Modifications Required
CT	Continuous Flow Total	LL	Low Limit Alarm	DSC	Daily Start Counter
DRT	Daily Run Time	DI	Discrete Input	SD	Smoke Detector
CRT	Continuous Run Time	DO	Discrete Output	EFD	Existing Field Device
Form C	Dry Contact Form C*	AI	Analog Input	AD	Auto-Dialer Inputs
EVT	Log Events of Status Change	AO	Analog Output	DS	Door Switch

SECTION - 16915

PROCESS INSTRUMENTATION AND CONTROLS - PRODUCTS

PART 1 - GENERAL

A. DESCRIPTION

1. Scope of Work:

a. Furnish and install all instrumentation and control system hereinafter specified to perform the intended function. Work shall include all labor, materials and equipment, performance of all work necessary to complete the manufacture, to make factory tests, to prepare and load for shipment, to deliver to the site, to provide programming, calibration, installation supervision including related field wiring, radio survey, system start-up, services, testing and incidentals required to completely furnish and install a programmable controller-based control and data acquisition system with instruments and control devices for the City of Titusville Armstrong Water Supply Facility including all work necessary during the Warranty Period, as specified herein: Warranties and Bonds, and shown on the Contract Drawings. The installation of the field instruments and related wiring shall be by the Contractor with the supervision by the Instrumentation and Control System Supplier.

B. QUALITY ASSURANCE

Qualification requirements are specified under Section 16900: Process Instrumentation and Controls - General Provisions.

C. SUBMITTALS

Refer to Section 16900: Process Instrumentation and Controls - General Provisions.

D. DOCUMENTATION

Refer to Section 16900: Process Instrumentation and Controls - General Provisions.

E. PRODUCT DELIVERY, STORAGE AND HANDLING

Refer to Section 16900: Process Instrumentation and Controls - General Provisions.

F. WARRANTY AND GUARANTEES

Refer to Section 16900: Process Instrumentation and Controls - General Provisions.

PART 2 - PRODUCTS

A. FUNCTIONAL DESCRIPTION

1. Automatic Operation Mode

a. The automatic mode will be used at all times unless there is an emergency situation that requires intervention. The automatic sequence will handle normal operations and periods of high demand due to infrastructure failure and fire protection.

b. The automatic mode of operation will consist of three phases; (1) Fill phase, (2) Re-Pump phase and (3) Stand-By phase

1) Fill Phase

a) Operations staff will determine the needed storage fill volume based on recent demands and determine the period of time for tank fill to occur. Normally, filling will occur to a level that will provide adequate water to meet the following day's demands, plus a surplus to provide a reservoir of water for abnormal events, such as water main breaks or fire flow demands. Staff will set the total demand from each source, Cocoa and Titusville (C & T), to be metered. Example: 500,000 gal. from Cocoa and 900,000 gal. from Titusville to obtain a total 1,400,000 gal., into the storage tank.

b) When the timer places the facility into Fill phase and a predetermined volume (not to exceed volume) of fill water is requested, the tank fill control valve digital controller (controls CV-6 & 7) will allow storage tank filling provided that available (C & T) water pressure is above minimum requirement and tank has available storage. The tank filling will occur from each source independently until the flow meter/totalizer indicates that the required total demand has been obtained and then closing the control valve to the source.

c) High tank level and end of fill mode (time) will also close tank fill control valves (CV Controller/ CV-6 and 7) regardless of the totalized demand indicator. When the goal volume has been met the Fill phase ends and the facility goes to Stand-By phase until the time for Re-Pump phase.

d) The control valve shall have the ability to open and close when required by the PLC for various reasons as described. The control valve controller will indicate instantaneous flow and totalized flow. The PLC will record totalized flow. The control valve controller will modulate flow to a pre-set rate of flow during the fill period. Typically, flow rates and maximum flow rates shall be as per an operator adjustable setpoint. Flow sustaining function provided by the control valve is controlled hydraulically. When the pressure

sustaining feature has closed the control valve to a flow rate below 20 GPM (default), the control valve shall be closed by PLC.

2) Re-Pump Phase

a) During the Re-Pump phase the tank fill control valves from (CV-6 & 7) will be closed. The distribution manifold control valve (CV-3) will be open and demand will be met using high service pumps to maintain a discharge pressure set point versus the actual pressure as per pressure transducer (PT-3 or PT-4). Pump sequence shall be set to operate one, then two and then three pumps as needed. The distribution flow meter FM-2 shall report flow rate and totalized flow to the PLC. Low water level in storage tank or end of re-pump phase timer will stop all pumps. If Re-Pump phase ends before Fill phase begins, the facility will be placed in Stand-By phase.

3) Stand-By Phase

a) The Stand-by or Default phase shall occur when neither tank filling or re-pump is required or when one of the other phases has ended and the time setting for the other has not occurred yet. The WSF shall monitor and report all sensors and settings during this phase. This phase may not be included in daily operational protocol and is essentially the default phase.

b. Water Quality Sampling/Disinfection System

1) The Armstrong WSF shall monitor water quality and verify that required disinfection residual levels are maintained in the storage tank. Continuous water samples will from each of the (C & T) source water fill lines as well as one sample point at the exit point of the storage tank. Each sample source will be analyzed by a dedicated automatic sampler (AS 1,2 & 3). Water sample analysis shall report to the PLC. The storage tank water sample shall control disinfection system needs. Should the water quality fall below a predetermined value, the disinfection system will automatically start and run as needed until the water quality returns to normal.

2) When activated, the controls shall energize the disinfection booster pump and both chemical feed skids including sodium hypochlorite and aqua ammonia feed. Disinfection dosing shall be paced by the PLC as per the following: storage tank water quality (1) discharge flow meter in compound loop control. Deactivation of the disinfection feed system shall result in de-energizing the chemical feed skids, followed by the disinfection booster pump after 2.0 (default) minutes.

3) Control range of disinfection shall consist of (PPM x Flow = GPH). The residual analyzer determines PPM. See Design Criteria Memorandum for specific dosage and range of the disinfection system.

c. Water Quality/Tank Mixer

1) The storage tank mixer improves storage tank water quality by maintaining homogenous storage volume, equalized disinfection residual and to help eliminate stratification within the tank. The mixer needs approximately 5 feet of water level to operate properly. Mixing operation shall be set by timer. The tank mixer will be inhibited anytime water level is below a minimum low level. The tank mixer will operate when tank level reaches 35 feet or greater, tank mixer will not operate when water level is less that 35 feet.

d. Digital Control Valve – Flow Metering/Flow Control System

1) The tank fill control valves (CV-6 and 7) will be provided with a digital programmed controller that is capable of measuring flow to +/- 2% accuracy as well as flow control (on-off-position change) and variable pressure sustaining function. The availability of pressure in water supply will be verified and sustained by the valve. The controller will supply flow rate and volume information to the PLC.

2. Manual Operation Mode

a. The manual mode will allow the system to be controlled remotely as needed. The phases of operation will remain the same as the automatic mode including all water quality functions but the control pressure will be adjusted to manage the system. No water would enter the tank and none will be pumped out. As the pressure set point is increased above current system pressure or zero, the system will default to the Re-Pump phase and the pumps would begin to operate to maintain the pressure set point. If the Fill phase is needed the SCADA system will have a control button to select the fill operation. The manual control mode will only be used to manage an emergency situation. Once the emergency situation is over the system will be returned to automatic. In manual operation mode, certain inhibit functions shall remain as follows:

1) Tank filling may not continue when the tank is full or when source water system pressure is below minimum setting.
2) Re-pump operation will not continue when the tank is below minimum level or when discharge pressure reaches a discharge system maximum.
3) Tank mixer will not operate when tank level is below required minimum level.

3. Default Settings

a. All devices mentioned in the operational protocol will report to the PLC regardless of function. All pressure set-points, tank level settings, or pre-

set minimums and maximums shall have a default setting that can be re-established by reset to default mode. All set-points and settings may be reset by operator modification under user mode(s). A default mode with all default settings shall be available without modification. The default phase may only be modified by PLC re-programming.

4. Booster Pump

   a. The existing two (2) booster pumps will be controlled manually from the SCADA system.

5. System Shutdown

   a. Power Failures

      i. Brief Power Interruptions:

         (a) When a brief power failure occurs and then is restored, the pumping shall be automatically be restarted in an operator adjustable, time staggered sequence to avoid system overload. The system shall not require operator assistance to restart the system.

6. Shutdown Alarm Logic

   a. PLC Alarm logic shall be per standard I.S.A. Sequence "F3A-3". Failures are identified by the following logic tables:

CONDITION		FIELD CONTACT	ALARM LIGHTS	HORN
Normal		Normal	Off	Off
Alarm	First	Abnormal	Fast Flashing	On
Alarm	All Subsequent	Abnormal	Slow Flashing	On
Silence	First	Abnormal	Fast Flashing	Off
Silence	All Subsequent	Abnormal	Slow Flashing	Off
Acknowledge	First	Abnormal	Slow Flashing	Off
Acknowledge	All Subsequent	Abnormal	Steady On	Off
Alarm Reset		Normal	Off	Off
Lamp Test		Normal	On	Off

7. Shutdown Recovery Procedure

   a. Annunciation

      i. A remote alarm will sound whenever a fault condition occurs.

      ii. An intermittent fast flashing light indicates the first condition that caused the failure.

iii. Subsequent alarms are indicated by a fast flashing light only.

8. System Resets

a. Alarm Acknowledge:

The ALARM ACKNOWLEDGE push-button is used to acknowledge any alarm. The first out alarm will change from the intermittent fast flashing indication to a slow flashing indication. All subsequent alarms will go from fast flashing to steady on indication.

b. First Out Reset:

The FIRST OUT RESET pushbutton to used to change the first out alarm indication from slow flashing to a steady on indication.

c. Alarm Reset:

The ALARM RESET pushbutton is used after an alarm problem is repaired to reset all alarm indications back to normal.

d. Individual Pump Reset

The pump failure lamp/pushbutton is used to reset a pump back in service after any major problem that caused the pump to fail has been repaired.

9. Project Specific Programming Instructions

a. The RTU program currently in the PLC shall be incorporated in any new software without any modifications for compatibility with existing Telemetry system with the exception that Pump Station control programming will be removed from the RTU function code (by City of Titusville Electronic Services (ES).
b. Except where noted on spreadsheet, the first 12 inputs (0-11) should remain unchanged unless approved by (ES).
c. Except as noted on I/O Addressing spreadsheet all other I/O that is currently in use will remain unchanged unless approved by ES.
d. MicroLogix 1500 will be used to maintain same data file system as is currently in place. This is for compatibility with existing Telemetry system.
e. Ethernet will be used for primary communications with serial radio used as backup.
f. Integer data file words N7:0 through N7:49 are reserved for data to be sent from the Armstrong PLC to the Water Plant Telemetry PLC.
g. Integer data file words N7:50 through N7:59 are reserved for data to be received from the Master Telemetry PLC. Words or bits already assigned will not be changed without approval by ES.
h. Alarms are derived by the HMI from the first 4 Integers (N7:0-N7:3). Inputs and Outputs that trigger alarms should be placed here. The number of Integers used will be expanded but should be contiguous. An Integer will contain an entire bank of direct digital I/O or a block of derived alarm bits.

i. Integer N7:49 is reserved for Time Sync from HMI and cannot be changed.

j. Binary Data files B3:0 through B3:10 are reserved for RTU Program functions. Control functions will use any above that. More may be added if needed.

k. Integer data file words N7:60 through N7:110 are reserved for RTU Programming (current file only goes to 104). This file will be increased as needed to accommodate the Control programming.

l. Float values F8:0 through F8:10 are reserved for RTU Programming (current file only goes to 3). This file will be increased as needed to accommodate the Control programming.

m. Timer files T4:0 through T4:20 and T4:39 are reserved for RTU Programming (current file goes to 39). The remaining files will be used or file size increased as needed to accommodate the Control programming.

n. Counter files C5:0 through C5:10 are reserved for RTU Programming (current file goes to 31). The remaining files will be used or file size increased as needed to accommodate the Control programming.

o. Only Integers are exchanged with remote PLC. Multiplying/Dividing number by 10, 100, etc. to preserve decimal places is acceptable. Adjustments will be made in HMI software.

p. The Master Telemetry PLC (ControlLogix 5550) polls all nodes using messages for data exchange. Remote PLC's (RTU's) do not initiate messages. Contact ES if it is necessary to initiate a message back to the Master PLC.

q. Program Files "LAD 2" and "LAD 6" through "LAD 10" and "LAD 15" are used by the RTU Programming. The remaining files will be used or more added as needed to accommodate the Control programming.

B. PANEL COMPONENTS

1. General:

a. Panel shall be completely fabricated, instruments installed, wired, and plumbed at the factory.

b. Panel shall be of sufficient size to adequately enclose all instruments plus 25 percent ample interior clearance to allow for installation, general servicing, future additions, and maintenance of the instruments. Weight of instruments shall be supported by channel supports where required.

2. Circuit Protection

a. Main Circuit Breakers - MCB

This breaker shall control the supplied 115 VAC primary power to all branch circuits within the panel.

b. Utilities Circuit Breakers - UCB

This breaker shall control the supplied 115 VAC power to the service outlet, internal lamp and light switch.

c. UPS Power Supply Branch Circuit Breaker CB-1

This breaker shall control the supplied 115 VAC power to the UPS power supply.

d. PLC Power Supply Branch Circuit Breaker CB-2

This breaker shall control the supplied 115 VAC UPS supplied power to the PLC 24Vdc power supply and radio modem.

e. I/O and Control Branch Circuit Breaker CB-3

This breaker shall control the supplied 115 VAC UPS supplied power to the dedicated PLC I/O and control additional 24V power sources.

f. I/O and Control Branch Circuit Breaker CB-4

This breaker shall control the supplied 115 VAC UPS supplied power to the dedicated chart recorders.

3. Panel Mounting

a. Panel Component Arrangements

i. Panel face mounted equipment shall consist of pilot-lights, pushbuttons, selector switches, meters, indicating timers, etc. Spacing between horizontal rows of components shall be 1-1/2 inches center to center minimum; spacing between vertical columns of components shall be 1-7/8 inches center to center minimum.

ii. The distance from the bottom row of components to the floor shall be not less than 36-inches. The top row of recording and indicating instruments shall be centered approximately 60 inches above the floor. The maximum height for annunciator windows shall be 85 inches above the floor. In general, all indicating lights, pushbuttons, etc. shall be mounted in accordance with the sequence of operation from left to right and top to bottom.

b. Rear of Panel Component Arrangements

i. All relays, timers, etc. installed on each panel subplate, shall be provided with a minimum spacing between the component and the wire duct of 1-1/2 inches above and one inch below. Minimum spacing between adjacent components shall be 1/4-inch.

ii. A minimum of 2-inches shall be provided between terminal strips and wire ducts or terminal strips and terminal strips. In general, terminal strips shall be mounted vertically near the outer edges of the subplate.

iii. Subplates shall have a minimum of 25% spare mounting space, and terminal strips shall have a minimum of 20% installed spare terminal blocks.

4. Temperature Control:

a. All panels shall permit continuous operation of all components with external ambient temperatures of up to 110° F. The supplier shall submit to the Owner a heat dissipation summary with calculations for each panel furnished to support the fact that the panel and internal components have been designed to operate properly in the exposed environment. Heat dissipation's shall be maximums and shall be given in BTU/Hr. Internal panel temperatures shall be maintained below 90° F.

b. Indoor panels, except for those with their backs directly adjacent to a wall, shall be provided with louvers on the rear of the panel located on the top and bottom of each access door, and shall be stamped sheet metal construction. For panels mounted with their backs directly adjacent to a wall, or with front access only, louvers shall be located on the sides. Forced air ventilation fans, where used, shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

5. Freestanding Panel Construction:

a. Existing enclosure to be utilized. Replace backplate with specified devices.

6. UPS Mode Selector

a. Uninterruptible Power Supply Operating Mode Selector Switch "By-passed" - "On-line"

The UPS unit shall provide uninterrupted power to the PLC, and 24 VDC power supplies. When the selector switch is placed in the "By-passed" mode, the UPS may be removed from the panel and allow the control system to continue to operate on the normal incoming AC service. Status of the position of the switch shall be monitored by the PLC.

7. Uninterruptible Power Source

a. The control panel shall operate from an Uninterruptible Power Source (UPS). Battery-supplied power shall be provided to operate the system for at least 45 minutes. The UPS shall utilize low maintenance, rechargeable, sealed batteries, maintained at a float charge during normal power conditions. The UPS shall output a synchronized 60 Hz sine-wave

output, in phase with the commercial line power sine wave. The sine-wave output shall be synchronized during switching from commercial AC power source to battery source and during switching from battery source back to commercial AC power source. The UPS shall switch to and from battery in less than 4 milliseconds. The UPS shall visually indicate its current mode of operation. The UPS shall provide silencing audible and visible alarms indicating commercial AC line power failure and low battery. The UPS shall support a serial port interface to communicate with the central site computer. This interface shall provide information to programmable controller to alert the utility staff in case of a power failure.

b. The UPS shall be the Smart-UPS 2200 manufactured by American Power Conversion, Inc.

8. Details:

a. General

i. All components and circuits used shall be subject to review and approval by the Owner. All switching circuits shall be checked and verified for specified performance by testing before shipment. All wiring shall comply with the latest applicable local and N.E.C. codes. Non-conforming circuits shall be corrected and re-tested.

ii. Each device requiring power shall be wired so that when wires are removed from any one device, power will not be disrupted to any other device.

iii. One isolated, N.O. spare contact shall be provided on each relay.

iv. Control device contacts going to high voltage equipment for motor control shall be rated 240 V ac/125 V dc at 10 amps. The contacts shall handle 50 amps inrush on "make" at 120 V ac and one amp on "break" at 125 V dc.

v. Fuses shall not be allowed where protection by circuit breakers will not void the warranty of the device.

b. Power Distribution within Panels:

i. A 120 volt, 1 phase panelboard shall be provided within the control panel with a 20 ampere, 1-pole main circuit breaker and a branch breakers for the service outlet and other panel loads. A service description for each breaker shall be clearly identified inside the distribution panelboard.

ii. Additional branch breakers shall be added as required. No more than 20 devices shall be feed from any one branch breaker. Fuse protection shall not be permitted unless provided as an integral part of a device or where breaker protection can not be provided.

Where fuse blocks are provided, they shall be the fusible disconnect switch type with blown fuse indicators. Branch circuit breakers rated for services of 0.1 to 15 amps shall be panel mounted as manufactured by Square "D" type GCB or Equivalent.

iii. A summary of the power requirements for each control panel furnished shall be submitted and indicated within each panel. Power requirements shall state required voltages, currents, and phase(s). Summary shall be supplemented with calculations.

c. Signal Distribution within Panels:

i. All signals shall be 24 VDC 4 to 20 mA signals.

ii. Signals distributed outside panels shall be isolated 4 to 20 mA signals.

iii. All signal wiring shall be twisted, shielded pairs, tinned copper.

iv. All field 4-20mA dc signals shall be isolated with an isolator AGM model AWD 1161 or Equivalent.

d. Signal Switching:

i. Signals shall be switched by dry circuit type relays or switches.

ii. 4 to 20 mA loops shall not be interrupted during switching.

iii. Switching transients in any associated signal circuit shall not exceed ±0.2 mA or ±0.05V depending on the signal type.

e. Relays:

i. Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. All relays shall have screw type terminal interface. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and all terminals are readily accessible.

ii. General-purpose relays shall be used for logic and switching power to external loads and shall be DIN rail mounted, general purpose, medium power, and industrial type. Minimum mechanical life expectancy shall be 10,000,000 operations and electrical life expectancy of 100,000 operations at rated load. They shall be of the dust cover enclosed, plug-in type, with 8 or 11 pin, screw terminal, snap-on sockets. Relays shall have a maximum of three form C contacts rated for 10 amperes at 120V ac and be equipped with visable “on” status indicator lamp and hold down springs.

Relays shall be as manufactured by Potter-Brumfield series KRPA, KUP, or approved equal.

f. Power Supplies:

i. Provide dc power supplies as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.

ii. Power supplies shall convert 120V ac, 60-Hz power to dc power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that the instruments being supplied can operate within their required tolerances.

iii. Output overvoltage and overcurrent protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure. Provide NEMA 1 enclosure for all power supplies. Power supplies shall be mounted such that dissipated heat does not adversely affect other components.

iv. Power supplies shall be manufactured by Acopian or equivalent.

g. Internal Panel Lights and Service Outlets:

i. Panels shall be provided with switched 22 watt flourescent back-of-panel lights. One light shall be provided for every 4 feet of panel width and shall be mounted inside and in the top of the back-of-panel area. Lights shall be provided with a protective shield.

ii. Panels shall be provided with a 15-amp, 120-volt, service outlet circuit within the back-of-panel area. The circuit shall be provided with three-wire, 120-volt, 15-ampere, duplex receptacles, one for every 4 feet of panel width (two minimum per panel) and spaced evenly along the back-of-panel area.

h. Wiring: Wiring within panels, consoles, racks, and cabinets shall meet the following requirements:

i. AC power wiring shall be 300 VAC, 12 AWG tinned stranded unless otherwise noted.

ii. All Discrete Output control wiring to be orange in color, no less than 300 VAC, 16 AWG, Tinned Stranded Copper type B/N 16/19 or Belden 8500 or XHHW, insulated wire or Equivalent.

iii. All Discrete Input control wiring to be red in color, no less than 300 VAC, 16 AWG, Tinned Stranded Copper type B/N 16/19 or Belden 8500 or XHHW, insulated wire or Equivalent.

iv. Control wiring routed to MCC shall be no less than 14 AWG Multiconductor Tray Cable, Stranded Copper type PVC, THWN or XHHW, insulated wire or Equivalent.

v. All internal analog wiring, (PLC to field terminal), shall be properly labeled and color coded White for positive and Black for negative polarity, no less than 18 AWG, Shielded Tinned Stranded Copper type Belden # 8719 or Equivalent.

vi. All analog field signal cable exiting enclosure, outer jacket shall be labeled with dot matrix printed shrink tube type wire labels. All shield drain wire shall be insulated and properly terminated per ISA and OEM standards. Labels shall identify terminal number, PLC logic reference number and affiliated process variable, properly color coded for positive and negative, no less than 16 AWG, Shielded Stranded Tinned Copper Signal type wire, Belden # 8719 or Equivalent.

vii. Wiring shall be numbered and tagged at each termination. Heat shrunk dot matrix wire markers shall be provided at each wire termination point internal and external to each panel(s). Wire tags shall be marked with legible machine printed markings and numbers. Adhesive or taped on tags will not be accepted. Each wire shall have a unique tag number assigned and be clearly identified on the approved shop drawings. Tagging scheme shall identify the designated component tag and terminal number destination.

viii. Wiring for special signals such as communications, digital data, and multiplexed signals shall use manufacturer's standard cables.

ix. All wires to internal components shall be connected to the "inside" of the field interface terminal strip. All wires to external components shall be connected to the "outside" of the field interface terminal strip. No more than two wires shall be connected to any one terminal point.

x. All panel wiring not run in wire ducts shall be bundled and tied.

xi. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

xii. Control and signal wiring shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the longitudinal axis of the wire and the bend area shall be protected with a sleeve.

ix. Where panel components are provided for future equipment, wiring from the components to the panel terminal blocks shall be provided.

iv. Wire Color Coding

(a) Power Wiring: Phase A shall be black with brown phasing tape, Phase B black with orange tape, and Phase C black with yellow tape.

(b) Internally powered AC Control Wiring: Control panel wiring associated with control circuits that are de-energized when the main panel disconnect is opened shall be color coded "Red".

(c) Externally powered AC Control Wiring: Control panel wiring associated with control circuits that remain "Hot" when the main panel disconnect is opened shall be color coded "Yellow".

(d) All yellow wiring leaving panels shall be brought to an isolated set of terminal blocks.

(e) Low voltage, DC Wiring: Blue (B+); Blue with-tracer (B-).

(f) DC Control Wiring: Black

(g) Neutral: White
Exception: Where prefabricated wire bundles are used, it is permissible to identify the neutral at every termination with a white shrink tube at least 12 inches long.

(h) Ground: Green

(i) Field interface wiring shall be black and white pairs unless otherwise noted or required by the National Electrical Code.

(j) Intrinsically safe: Light Blue

(k) 24 VAC power wire shall be orange and brown.

xv. Wire Duct

(a) Panel wire duct shall be provided between each row of components and adjacent to each terminal strip. Wire ducts shall be a minimum of one inch wide and three inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wire ducts shall be constructed of non-metallic materials with a voltage

insulation in excess of the maximum voltage carried therein.

(b) Empty panel wire duct shall be provided for all field connections to the terminal blocks.

(c) A minimum of two inches shall be provided between wire duct and terminal block assemblies

(d) Wiring duct shall not be filled to more than 60% visible fill.

i. Wiring Interface: All wiring including spares entering or leaving each panel, console, rack or cabinet shall be terminated and identified as follows:

i. Analog and discrete signal wiring shall be terminated at numbered terminal blocks. All wire shall be labeled with terminal number and PLC logic reference number.

ii. Wiring for special signals such as communications, digital data, and multiplexed signals may be terminated at manufacturer's standard connectors.

j. Terminal Blocks: Terminal blocks for panels, consoles, racks, and cabinets shall meet the following requirements:

i. All terminal blocks shall be 600-volt rated and shall be provided for termination of all circuits entering or leaving all panels. Terminal blocks shall have screw clamp compression, dead front barriers with current bar providing direct contact with wire between the compression screw and yoke. Yoke, current bar, and clamping screw shall be constructed of high strength and high conductivity metal. Yoke assembly shall guide all strands of wire into the terminal. Current bar shall provide dependable vibration-proof connections. Terminals shall be constructed to allow connection of wires without any special preparation other than stripping. Individual terminals shall be rail mounted to create a complete assembly such that jumpers can be installed with no loss of space on terminal or rail.

ii. Terminal block components shall be sized to allow insertion of all necessary wire sizes and types. Legible, factory machine printed markings and numbers shall be provided for terminal block identifications on both the inside and outside tracks of the terminal block assembly. Terminal blocks shall be numbered in numerical order.

iii. Sufficient terminal blocks shall be provided to terminate all wires routed to the panel, all spare annunciator points and spare

conductors. In addition, the greatest of 20 percent or four unused spare terminals shall be provided

iv. All connections for future functions shall be wired to numbered terminal blocks, grouped separate from the terminal blocks in use. Terminal blocks shall be grouped to keep 120V ac circuits separate from the 24V dc circuits.

v. Terminal blocks shall be CSA certified and UL approved.

vi. Control type terminal blocks shall be as manufactured by WAGO, Entrlec, SQ-D or Equivalent.or Owner approved equal. Analog signals (4-20 mA dc) shall be connected to knife type disconnect terminal. Shields required to be grounded shall be terminated. Signal shields shall be grounded at only point within a loop. Use blocks when passing the shields through.

k. Grounding: Panels, consoles, racks and cabinets shall be provided with an isolated copper grounding bus for all signal and shield ground connections. This ground bus shall be grounded at a common signal ground point. The signal grounding system shall meet National Electrical Code requirements.

i. Each analog loop shall be grounded at a single point for the loop. This single point shall be at location of the dc power supply for the loop.

ii. Each analog loop shall have its wire shields connected to ground at a single point for the loop. Shields shall be grouped and connected to ground at the same point as the analog signal ground.

l. Analog Signal Isolators: Instruments on different panels, cabinets, or enclosures shall not be wired in series. Provide analog signal isolators for analog signals that are sent from one panel or cabinet to another.

Analog Signal Isolators and Surge Protectors: Instruments on different panels, cabinets, or enclosures shall not be wired in series. Provide analog signal isolators for analog signals that are sent from one panel or cabinet to another. All analog signals entering or leaving the control system shall be protected by a surge arrester as manufactured by Dihn “Blitzductor” SP BE 24’ P/N 926-324 (surge) with ‘BXT/BSP’ Base P/N 920 300.. Surge arresters shall be labeled.

m. Programmable Logic Controllers

i. General:

(a) The programmable logic controller (PLC), as specified herein, shall be provided under this section and located within the control panel.

ii. Programmable Controller:

(a) The control systems shall be automatically controlled by a Allen-Bradley Micro-1500 with Ethernet port programmable logic controllers (PLC) with dual communication capabilities. The input/output modules shall be mounted on panel mounted I/O racks.

(b) Each discrete input module shall accept 120VAC input signals received from devices such as pushbuttons, selector switches, pressure switches, temperature switches, or limit switches and converts them into voltage logic levels that can be processed by the controller. Input signals shall be wired in two (2) groups of eight signals per module. Each group of eight points shall be protected by a .16 amp external indicating fuse block. Each input shall be optically isolated and protected with a red LED to indicate the presence of the 24Vdc power (circuit closed indication). A green LED shall be provided to indicate the presence of the I/O module supply voltage of each group. discrete input modules shall be as manufactured by Allen-Bradley.

(c) Each discrete output module shall provide relay switched, 120 VAC output signals that can drive loads up to 1 amp such as relays, starters, and solenoid valves. The outputs shall be optically isolated from the system. Output signals shall be field wired in two groups of four (4) outputs per module. Each group of four points shall be protected by an external .16A indicating fuse block. Each output shall be isolated and provided with a red LED to indicate the output is turned "on". A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. External, panel mounted, 10Amp, interposing relays shall be provided for interfacing to control devices that are external to the local control panel or to devices that exceed the rating of the output module. Where LED type status indicators are used, a loading resister shall be installed to prevent leakage current from keeping the lamps falsely lit. Discrete input modules shall be as manufactured by Allen-Bradley

(d) Analog input modules shall be opto-isolation. Inputs shall accept 4-20mA DC signals. Input shall be set for Unipolar with Offset and Extended Resolution mode to detect loss of signal or low input indication. Resolution shall be 11 bit plus sign with a 10 ms conversion time. The input shall be

protected by an external .16A indicating fuse block. A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. A second green LED shall be provided to indicate the module is healthy. Removal of any panel mounted devices shall not interrupt the input signals to the PLC. Analog values shall continue to function properly. Inputs shall be provided for Flow and Level. Analog input modules shall be as manufactured by Allen-Bradley.

(e) The PLC memory shall be 14kB user program capacity (10 kB User Program with 4 kB User Data)

(f) Battery-backed memory shall be protected by a 3.6V Lithium battery with the battery condition monitored by the processor. When the battery needs replacement, as indicated by the "low Battery" status lamp on the processor or "PM Required" lamp on the front of the local panel, a remote alarm will be initiated.

iii. PLC Ladder Logic Software

(a) The Primary Instrumentation and Control System Supplier shall program PLC to perform, and warrant proper system operation as described in this document.

(b) The Owner shall be sole owner of all programming software described in this contract, the use of any proprietary software other than described in this contract will not be accepted.

(c) All points used in Ladder logic shall be documented and labeled so Owners personal can identify each point and its function.

(d) Control (Command) points shall be programmed such that control can be performed from HAND field devices (such as a selector switch or pushbutton) or from REMOTE by MMI software, as described in contract. In some applications this will require that OR logic be in the program. The control description shall include how the MMI software should handle the commands.
For example Only: to turn on Blower #3 , the MMI software should pulse address 02001 and to turn the pump off the software should pulse the same address 02001 again.

(e) Programmer shall keep the amount of points needed to control equipment to a minimum, project is licensed to a limited amount of MMI points to be used.

(f) Provide a Device Specific, Control Description in one (1) document. The document shall provide all information about controlling each specific device in the same area of the document. This prevents the user from looking in 4 different places for information on 1 device.

(g) All descriptions shall be grouped by piece of equipment, functional description and address in the PLC. The documentation shall be created in a Excel spreadsheet format on optical disk and 8.5x11 printout.

EXAMPLE:

Device	Description	0 State	Address
Pump 101	Run Status	Stopped	10001
Pump 101	Failed Status	OK	10022

(h) All Analog values in the PLC ladder logic program documentation shall include scaling values and engineering units. The documentation shall be in a Excel spreadsheet format on CD or DVD and 8.5x11 printout..
EXAMPLE:

Description	Address	Data Type	Raw Zero	Raw Full Scale	Eng Units Zero	Eng Units Full Scale	Units
RAS Flow	300010	INT	0	4095	0	300	GPM

(i) Documentation shall also state any special conditions that must be met to control a piece of equipment. For example if a pump must be in manual for the MMI system to turn the pump on or off this shall be documented. (IE. Pump 101 can only be directly controlled by the MMI system if it is in the manual condition).

(j) Provide documentation and 3.5 disk for all PLC logic.

(m) Primary Instrumentation and Control System Supplier shall furnish Owner Technicians with Basic PLC Operation training.

n. Operator Interface

i. The operator interface shall be PanelView™ Plus 6 1500 graphic terminal has a 15 inch. flat-panel color display with 1024 x 768 resolution and 18-bit graphics. Operator terminal shall support operator input via keypad and touch screen, 512MB memory, and Windows® CE 6.0 operating system. Operator terminal shall include FactoryTalk view studio machine edition.

C. SYSTEM SOFTWARE

1. General Description

a. The system shall include the following graphics:

i Tank Fill
ii High Serive Pumping

2. Process Graphic Displays:

a. Display Coordination Meeting: Prior to the entering of the process graphic displays, a coordination meeting shall be held to establish the following:

i. Graphic symbols to be used on displays.

ii. Conventions for color usage.

iii. Conventions for showing alarm conditions, device status, and process variable values.

iv. Conventions for naming and identifying devices.

v. Breakdown of the process into individual displays.

vi. Preliminary layout for the overview displays and for each process graphic display.

b. Displays: Process graphic displays shall be of the process schematic type. The typical as a minimum shall include:

i. Process Flow Streams: Color code and identify process flow streams. Interfaces between graphic displays shall be identified.

ii. Process Structures: Basins, tanks, piping, etc.

iii. Major Equipment Items: Pumps,, drives, etc.

iv. Major Control Devices: valves, etc.

v. Instruments.

vi. Targets to link a display to associated displays. This will allow movement between graphic displays without the necessity of knowing or entering the display identification code.

c. Overviews: Overview displays shall show primary process data. Detailed displays shall show, on a real-time basis, the state of all monitored and

controlled devices including control loop status and other applicable information from the data base.

d. Colors: Label all parameters and show all values in engineering units. Show alarm and device status with four-state colored graphic symbols.

e. Access to Point Parameters: Provide access through each individual process graphic display for display and modification of control related data base parameters. This access shall be the user's normal method of changing data base parameters including, but not limited to, tuning constants, scan inhibited status, manually set value, set points, and AUTO/MANUAL control status. parameters shall be accessed through use of targets and/or function keys.

f. Alarm Window: A dedicated area of each display shall be able to be reserved for display of the most recent alarms. Unless otherwise noted, the top two lines of each process graphic display shall be reserved for an alarm window.

g. Real Time Trends: Include graphic displays to show the real-time trends.

h. Required Process Graphic Displays: Provide a complete set of process graphic displays. In addition, provide the capacity to handle at least two times this number of process graphic displays.

H. FIELD MOUNTED INSTRUMENTS

1. Magnetic Flow Meters

Tags: FE/FIT-400 Ammonia Feed
FE/FIT-500 Liquid Chlorine Feed

1) Accuracy to +/-2.0%
2) Flows from 0.8 to 1426 GPH
3) Pressures to 145 PSI
4) Fluid temperatures to 140 F
5) Compatible with pulsating flows
6) Easy to install threaded connections
7) Outputs: Pulse, Error, Alarm.
8) Manufactured by Flomotion Systems FM series

2. Chlorine Analyzers

Tags: AE/AIT-100 Fill Anaylzers
AE/AIT-200 Storage Anaylzers

1) Furnish and install chlorine analyzers as manufactured by Siemens Depolox 3.

2) Specifications

a. Range: 0 to 20mg/L free or total residual chlorine
b. Accuracy: ±6% full scale
c. Sensitivity: ±1% full scale.
d. Repeatability: ±5% full scale
e. Stability: ±3% full scale
f. Response Time: 90% < 5 minutes
g. Sample Flow: 6-35 l/h constant
h. Inlet Pressure: 2-60psi
i. Outputs: One 4-20 mA with an output span programmable over any portion of the 0 to 20 mg/L range. 130V isolation from earth ground.
j. Alarms: Two alarms selectable for sample concentration, system warning or system shut-down. Each alarm is equipped with an SPDT relay with contacts rated for 5 A resistive load at 230 VAC.
k. Power: 100-115/230 VAC, 50/60 Hz (switch selectable), 90 VA maximum.
l. Enclosure: ABS plastic, IP62 enclosure rating with two clear polycarbonate windows.

4) Provide transient surge protection for the incoming 120VAC and DC signals as manufactured by Dehn 'Blitzductor SP BE 24' P/N 926-324 (surge) with 'BXT/BSP' Base P/N 920 300 mounted in a stainless steel box.

5) Sample pump shall be of the submersible type with 25 foot of cord, stainless steel chain and hook as manufactured by Little Giant 6E-CIM or Equivalent

3. Pressure Transmitters

Tags: PE/PIT-301 Primary Distribution Pressure
PE/PIT-302 Back-up Distribution Pressure

1) Type:

a. Capacitance Cell

b. Electronic Output.

c. NEMA 4X enclosure.

2) Operation:

a. Purpose - To sense variations in pressure and produce a standard current output signal linear with the pressure.

3) Functional:

a. Power Supply - 10-30Vdc

c. Output - 4-20 mA dc.

d. Process Connections - 1/2-inch NPT-

4) Physical:

a. Body Material –stainless steel

b. Wetted Parts - 316 SST

c. Electronics Housing –stainless steel.

5) Performance:

a. Accuracy - plus or minus 0.25 percent of span.

6) Provide transient surge protection for the incoming DC signals as manufactured by EDCO PC642 series mounted in a stainless steel box.

7) Manufacturer:

a. Wika Model S-10

4. Venturi Flow Meter

A. General: The metering primary element shall be of the pressure differential producing type utilizing pure static pressure sensed at the inlet and throat sections. The venturi meter supplier shall provide written certification that the cast iron portion of the meter is of North American origin in order to insure that it meets applicable ASTM code requirements. In addition, in order to insure a high level of quality control in the design and manufacturing of the venturi meter, the venturi meter manufacturer must be ISO 9001 certified. A copy of the current certification shall be included in the submittal for approval documentation. If any parts of the meter contain a welded joint, the manufacturer shall hold a valid and current ASME S, U & R code stamp to insure proper weld design and quality The manufacturer of the Venturi meter shall have a minimum of 20 years experience in providing differential type flow meters of the type and design specified

B. Required Features:

1. Inlet section shall be comprised of a cylindrical section, of similar diameter as the pipe, in which the high pressure tap is installed and shall incorporate to condition the flow profile before it enters the throat section.

2. Laying length of the throat shall be at least 0.5 times the throat diameter. Low pressure tap shall be installed in this section.

Outlet cone shall be truncated, having an included angle of 10 degrees.

3. Differential pressure shall indicate static pressure change only. Devices employing entire or partial Pitot effects, amplifying differential by changing flow direction at the point of sensing pressure, thus introducing unwanted hydraulic noise, shall not be acceptable.

4. The Venturi flow meter shall have an accuracy of +/-0.5% of actual flow above a pipe Reynolds number of 75,000 with a discharge coefficient of 0.9900 and a permanent pressure loss not exceeding 10% of the differential.

5. The Venturi meter shall have a cylindrical inlet section of the same I. D. as the inlet piping and shall contain two high pressure taps and a single vent and drain tap. The cylindrical 304 stainless steel throat section shall contain two low-pressure taps. The body shall be cast iron. The length of the cylindrical throat section shall be equal to one-half its diameter. The converging section shall be comprised of a single angle of 30 degrees. Converging sections using a radius or multiple inlet angles will not be acceptable. The recovery section shall be comprised of a single angle of 10 degrees and shall be truncated at approximately 90 % of the downstream pipe I.D. The Venturi shall be provided AWWA type 125/150 pound flanged ends unless otherwise specified. Coating of interior cast iron surfaces shall be NSF-61 epoxy, coating of exterior surface shall be shop primer, blue.

6. The venturi meter design shall be based on the following criteria:

    a. Line Size: 24.0 inches to be installed in DI pipe
    b. Ends: 125/150# ANSI Design, cast iron
    c. Flow Rates:
        (1) Minimum flow rate is 1250 GPM
        (2) Maximum flow rate is 5300 GPM
    d. Differential:
        (1) Differential at the minimum flow rate shall be 5.23” w.c..
        (2) Differential at the maximum flow rate shall be 94.11” w.c..

7. Metering element shall not have debris collecting cavities or annular chambers, but shall have a single pressure connection at the inlet and throat. In addition, a vent port and drain shall be included on a 90 degree plane to the metering tap on the inlet section.

8. Approval data shall state and substantiate the value and tolerance of the coefficient, the effect of up and downstream piping configurations, the head loss in percent of pipe velocity head and

shall provide proof that the coefficient is independent of line size and Beta ratio.

9. Each Venturi meter shall be flow calibrated by an independent flow lab and provided with certified copies of the test results to substantiate the flow meter's accuracy, discharge coefficient and permanent pressure loss. In lieu of lab flow calibration, the manufacturer may provide prior independent lab test data substantiating the flow meter's accuracy, Reynolds number performance, installation effects, discharge coefficient, and head loss. Prior test data shall cover at least 36 lab calibrations in sizes from 2.0 to 48.0 inches

C. Manufacturer: Provide venturi tubes of one of the following:

1. Primary Flow Signal HVT-CI.
2. BIF

D. Flow Transmitter:

1. Local indicator shall be suitable for pipestand mounting in a full enclosure as manufactuered by O'Brien GRP with internal 120VAC heater.

2. Unit shall receive the differential pressure resulting from the passage of the process fluid through a flow meter and display said differential pressure.

3. Transmitter shall include stainless steel 3-valve manifold.

4. Transmitter shall be of the capacitance type with a process-isolated diaphragm with silicone oil fill, microprocessor-based "smart" electronics, and a field adjustable rangeablility of 100:1 input range. Span and zero shall be continuously adjustable externally over the entire range. Span and zero adjustments shall be capable of being disabled internally. Transmitters shall be NEMA 4X weatherproof and corrosion resistant construction with low-copper aluminum body and 316 stainless steel process wetted parts. Accuracy, including nonlinearity, hysteresis and repeatability errors shall be plus or minus 0.065 percent of calibrated span, zero based. The maximum zero elevation and maximum zero suppression shall be adjustable to anywhere within sensor limits. Output shall be linear isolated 4-20 milliamperes 24 VDC. Power supply shall be 24 VDC, two-wire design. Transmitter shall be furnished with a 4-digit LCD indicator capable of displaying engineering units and/or milliamps and mounting hardware as required. Overload capacity shall be rated at a minimum of 25MPa. Environmental limits shall be -40 to 85 degrees Celsius at 0-100% relative humidity. Transmitter shall have a stainless steel tag with calibration data

attached to body. Differential pressure units shall be furnished with close coupled stainless steel three valve manifold assembly. The electronics sections of differential pressure transmitters shall contain user-selectable square root extractors to provide a linear 4-20 mA DC output proportional to flow, when activated. Square root extractor circuitry shall be activated on the flow transmitters listed in the Instrument Schedules. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter.

5. Differential pressure indicating transmitters shall be Model 3051C as manufactured by Rosemount, or equal.

I. I/O SCHEDULE

See Table 16915-1.

PART 3 - EXECUTION

A. GENERAL INSTALLATION

1. The control system, peripherals, and accessory equipment shall be installed in accordance with the requirements set forth under Section 16900: Process Instrumentation and Control-General Provisions.

B. TESTS AND ACCEPTANCE

Field and system tests, and acceptance requirements are specified under Section 16900: Process Instrumentation and Control - General Provisions.

C. MAINTENANCE CONTRACT

Maintenance contract requirements are specified under Section 16900: Process Instrumentation and Controls - General Provisions.

D. INSTRUCTION

Personnel training requirements are specified under Section 16900: Process Instrumentation and Controls - General Provisions.

END OF SECTION

Florida Department of Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Rick Scott
Governor

Jennifer Carroll
Lt. Governor

Herschel T. Vinyard Jr.
Secretary

SENT BY EMAIL
Jimmy.Gager@titusville.com

City of Titusville-Water Resources Department
2836 Garden Street
Titusville, FL 32796

Attention: Jimmy Gager
Safety and Special Projects Manager

Brevard County-PW
City of Titusville-PWS ID 3051367
Permit Modifications to the Armstrong Water Supply Facility

Dear Mr. Gager:

Enclosed is Permit Number WC05-0080430-196 to modify the Titusville Armstrong Water Supply Facility at 1500 Armstrong Drive in Titusville, issued pursuant to Section 403.861(9), *Florida Statutes*.

The Department's proposed agency action shall become final unless a timely petition for an administrative hearing is filed under Sections 120.569 and 120.57 of the *Florida Statutes* before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. The petition must contain the information set forth below and must be filed (received by the Clerk) with:

Clerk of the Department of Environmental Protection
Office of General Counsel
3900 Commonwealth Boulevard, Mail Station 35
Tallahassee, Florida 32399-3000

Petitions by the applicant or any of the parties listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any persons other than those entitled to written notice under Section 120.60(3) of the *Florida Statutes* must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first.

Under Section 120.60(3) of the *Florida Statutes*, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the *Florida Statutes*. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the *Florida Administrative Code*.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301, *Florida Statutes.*

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the *Florida Statutes* is not available for this proceeding.

This action is final and effective on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the *Florida Statutes*, by the filing of a notice of appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with:

Clerk of the Department of Environmental Protection
Office of General Counsel
Mail Station 35,
3900 Commonwealth Boulevard
Tallahassee, Florida, 32399-3000

and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

Florida Department of Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Rick Scott
Governor

Jennifer Carroll
Lt. Governor

Herschel T. Vinyard Jr.
Secretary

NOTICE OF PERMIT ISSUANCE

This permit is issued under the provisions of Chapter 403, *Florida Statutes*, and Rule 62-555, *Florida Administrative Code*, (F.A.C.). The above named permittee is hereby authorized to perform the work shown on the application and approved drawing, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

This permit is to modify the Armstrong Water Supply Facility at 1500 Armstrong Drive in Titusville. This existing facility acts as an interconnection between the Titusville and Cocoa water systems and will operate as an automated storage and re-pumping facility with the ability to monitor water disinfection residuals and provide secondary disinfection when needed. The facility will be capable of control from the Mourning Dove water treatment plant (WTP).

The modifications related to this permit application include the following (or their equivalents):

- Replacement of the existing three high service pumps (HSP) HS-4 (2800 gpm), HS-5 (5600 gpm), and HS-6 (5600 gpm) with Peerless 6AE14 horizontal split case single staged pumps rated 1675 gpm @105 ft. TDH, 60 HP, and 1775 rpm;
- New tank fill piping;
- 12-inch McCrometer, Ultra-Mag Model UM06 electromagnetic flow meter;
- New tank fill and high service discharge flow meters that will allow additional Cocoa water to enter the distribution system through control valve CV-2;
- Two (2) new USFilter/Wallace & Tiernan Deplox 3 automatic water samples;
- One (1) modified disinfection system on a skid consisting of sodium hypochlorite and aqueous ammonia solutions stored in plastic carboy containers of approximately 50-55 gallons; the sodium hypochlorite or chlorine solution metering pumps shall be Grundfos Model DME 48-3 AR-PV/V/C-F-21SSB capable of 12.68 gph@38 psig and the aqueous ammonia solution metering pumps shall be Grundfos DME8-10 AR-PV/T/T 21RRB capable of 1.98 gph@145 PSIG.
- removal of the gas chlorination feed equipment;
- One (1) new programmable logic controller (PLC) connected to SCADA for remote supervision;
- Connection of a proposed 10-inch and 12-inch water main to an existing 24-inch water main and an existing 10-inch water main near the intersection of Grissom Parkway and Armstrong Drive. The purpose of this connection is to decrease the water age in the mains.

The Titusville water supply main is not dedicated and therefore must either be supplying water to this facility or providing water distribution to the system, away from this facility. Currently, the Cocoa water supply line is dedicated and therefore may supply water to this facility during both tank filling and distribution periods. The operation of control valve CV-2 during the fill or re-pump phase will allow for additional Cocoa water to enter the distribution system.

This permit does not pertain to any wastewater, stormwater or dredge and fill aspects of the project. This permit is issued based upon the dates and submissions during the application process as follows: Construction plans, calculations, and correspondence received on July 29, 2011 and June 23, 2011. This permit expires 5 years from the date of issuance.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violations of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in subsections 403.087(6) and 403.722(5), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

    a) Have access to and copy any records that must be kept under conditions of the permit;

    b) Inspect the facility, equipment, practices, or operations regulated or required under this permit; and

    c) Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

    Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any conditions or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

    a) A description of and cause of noncompliance; and

    b) The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

    The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Section 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Rule 62-4.120 and 62-30.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

13. The permittee shall comply with the following:

    a) Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.

    b) The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date the sample, measurement, report, or application unless otherwise specified by Department rule.

    c) Records of monitoring information shall include:

        1. The date, exact place, and time of sampling or measurements;
        2. The person responsible for performing the sampling or measurements;
        3. The date analyses were performed;
        4. The person responsible for performing the analyses;
        5. The analytical techniques or methods used;
        6. The results of such analyses.

14. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

SPECIFIC CONDITIONS:

1. A clearance letter must be issued by the DEP Central District Potable Water program before placement of this project into service. Failure to do so will result in enforcement action against the permittee.
2. To obtain a clearance letter, the engineer of record must submit/perform the following:
    a) Completion of the enclosed "Request for Letter of Release to Place Water Supply System into Service" [DEP Form 62-555.900(9), F.A.C.];
    b) A copy of this permit;
    c) Bacteriological results from two consecutive days at the following locations: (1) point of entry to the water distribution system; and (2) discharge side of the three pumps.
    d) Proof that the aqueous ammonia used at the plant is approved by the National Sanitation Foundation.
    e) Contact Javed Mayet at (407) 897-4128 after all of the equipment has been installed but before the clearance package has been submitted to the Department.

    Refer all questions about clearance issues to Kyle Kubanek at (407) 897-4127.
3. NOTE TO THE UTILITY: Pursuant to Section 403.859(6), Florida Statutes, do not provide water service to this project (other than flushing/testing) until the Department of Environmental Protection has issued a letter of clearance or the utility, shall be subject to enforcement action.
4. The permittee will promptly notify the Department upon sale or legal transfer of the permitted facility. In accordance with General Condition #11 of this permit, this permit is transferable only upon Department approval. ***The new owner must apply, by letter, for a transfer of permit within 30 days following sale or transaction.***
5. The permittee shall retain a Florida-licensed professional engineer in accordance with Rule 62-555.530(3), F.A.C. to take responsible charge of inspecting construction of the project for the purpose of determining in general if the construction proceeds in compliance with the permit, including the approved preliminary design report or drawings and specifications, for the project.
6. The permittee shall have complete record drawings produced for the project in accordance with Rule 62-555.530(4), F.A.C.
7. The permittee shall provide an operation and maintenance manual for the new or altered treatment facilities to fulfill the requirements under Rule 62-555.350(13), F.A.C.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Christianne C. Ferraro, P.E.
Administrator, Water Resource Management

Date of Permit Issuance: October 3, 2011

Date of Permit Expiration: October 2, 2016

cc: Engineer of Record: Ed Wardingley, P.E. City of Titusville [Ed.Wardingley@titusville.com]
FDEP: Richard Lott; Kim Dodson; Reggie Phillips; Nathan Hess; Kyle Kubanek;

FILING AND ACKNOWLEDGMENT

FILED, on this date, under Section 120.52(7), *Florida Statutes*, with the designated Department Clerk, receipt of which is hereby acknowledged.

Tricia L. Young
Clerk

October 3, 2011
Date

CERTIFICATE OF SERVICE

The undersigned hereby acknowledges that this **NOTICE OF PERMIT ISSUANCE** and all copies were sent by email before the close of business on October 3, 2011 to the listed persons.

Maggie E. Nagy
Signature

BREVARD COUNTY PUBLIC WORKS
2725 Judge Fran Jamieson Way, Building A
Viera Fl 32940
(321) 637-5437 phone (321) 633-2083 fax

PERMIT #: 12RW-00110
ISSUED: 02/03/2012
EXPIRES: 02/03/2013

RIGHT-OF-WAY AND EASEMENT PERMIT
PERMIT TO BE POSTED AT JOB

SITE ADDRESS: GRISSOM PKWY. & ARMSTRONG DR. TITUSVILLE

SUBDIVISION NAME:

DESCRIPTION OF WORK: 1- 10" DIRECTIONAL BORE (60LF) UNDER GRISSOM PKWY N. OF ARMSTRONG DR., TITUSVILLE, 32796

OWNER: CITY OF TITUSVILLE / JANET ELROD
OWNER ADDRESS: 2836 GARDEN STREET
TITUSVILLE FL 32796
PHONE: (321)383-5668

APPLICANT/CONTRACTOR: CITY OF TITUSVILLE
ADDRESS: 2836 GARDEN STREET
TITUSVILLE FL 32796
PHONE: (321)383-5668

PERMITEE RESPONSIBLE FOR DAMAGES TO ROAD/EASEMENTS DURING CONSTRUCTION.

OPEN PITS MUST BE COMPLETED WITHIN 10 DAYS OF EXCAVATION. NO EXCAVATION WITHIN 4 FT OF EDGE OF PAVEMENT

RESTORE AND SOD ALL AREAS DISTURBED BY CONSTRUCTION IN COUNTY RIGHT-OF-WAY OR EASEMENT.

MAINTAIN PROPER MAINTENANCE OF TRAFFIC (MOT) ATTACHED OR AS STATED ON PLANS.

PERMIT MUST BE ON-SITE FOR ALL INSPECTIONS. IF PERMIT IS UNAVAILABLE ON-SITE, THE SCHEDULED INSPECTION WILL NOT BE PERFORMED AND YOU WILL BE ASSESSED A $75.00 REINSPECTION FEE WHICH WILL BE DUE PRIOR TO RESCHEDULING.

RIGHT-OF-WAY INSPECTIONS OFFICE MUST BE NOTIFIED 48 HOURS PRIOR TO START DATE ON UTILITY CONSTRUCTION AND COMMERCIAL PROJECTS. FOR COMMERCIAL SITE AND RIGHT-OF-WAY INSPECTIONS, PLEASE CALL (321) 633-2079.

RESIDENTIAL PRE-POUR AND FINAL INSPECTIONS MUST BE CALLED IN 24 HOURS IN ADVANCE AND BY 4:30 PM TO BE INSPECTED THE FOLLOWING BUSINESS DAY. PHONE (321) 633-2079.

CALL BEFORE YOU DIG (800) 432-4770.

APPLICANT MUST COMPLY WITH F.S.556 FOR UTILITY LOCATION INFORMATION.

BY ACCEPTANCE OF THIS PERMIT, THE PERMITEE AGREES TO THE TERMS AND CONDITIONS OF THIS PERMIT.

PERMIT ACCEPTANCE SIGNATURE:_____

PERMIT CONDITIONS:

PER ATTACHED BREVARD COUNTY STANDARD CONSTRUCTION NOTES

BREVARD County
BOARD OF COUNTY COMMISSIONERS

FLORIDA'S SPACE COAST

Public Works Department
Development Review & Construction Inspection
Government Center Bldg. A, Room 204
2725 Judge Fran Jamieson Way, Viera, FL 32940

Phone: (321) 637-5437
Fax: (321) 633-2083

STANDARD CONSTRUCTION NOTES FOR WORK CONDUCTED IN BREVARD COUNTY RIGHT OF WAYS

1. All disturbed areas within the county right of way shall be sodded. Seed & Mulch is not acceptable.

2. All Directional Bores must extend a minimum 8 (eight) feet past the edge of pavement of any roadway or commercial driveway. For private residential driveways the bore must extend 3 (three) feet past the driveway. For private and commercial sidewalks the bore must extend 3 (three) feet on either side.

3. All Directional Bores shall be in accordance with FDOT Standard Specifications for Road and Bridge Construction Section 555, Directional Bores and the FDOT Utilities Accommodation Manual.

4. Any damage to the existing infrastructure, including sidewalks, by the contractor must be replaced prior to final inspection. Sidewalk patching is not acceptable.

5. A visual or mechanical inspection of the existing culvert(s) will be required prior to final inspection.

6. A minimum of 18 (eighteen) inches of separation will be maintained with stormwater piping.

7. Existing drainage swales and / or culverts will be maintained during proposed Trench / Bore operations and will be restored to original conditions.

8. Please be aware, as of 12/1/10, that all open cuts shall have flowable fill and temporary or permanent asphalt installed within thirty (30) days of excavation.

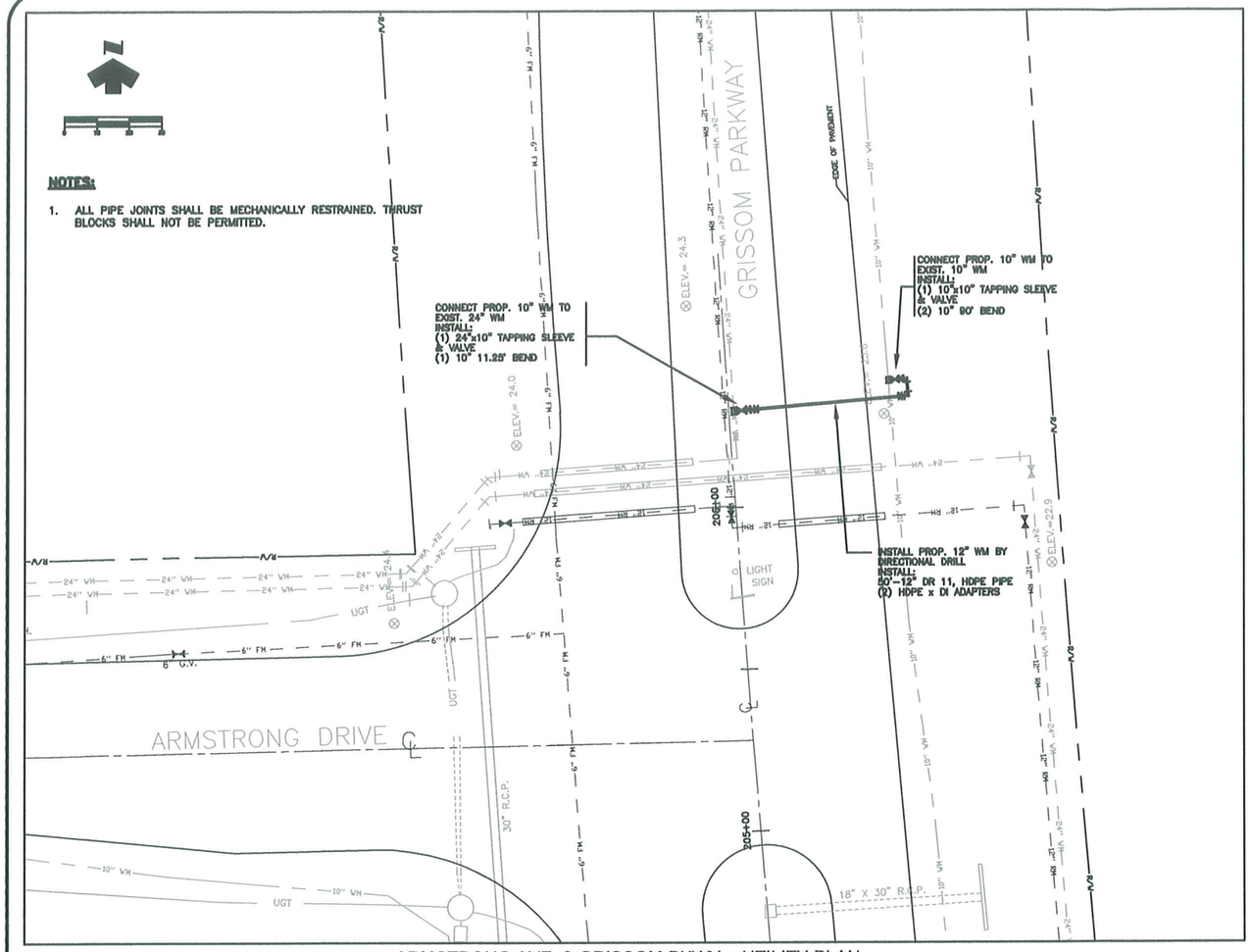
9. Open pits must be completed within ten (10) days of excavation. No excavation within four (4) feet of the edge of pavement.

10. **General MOT Review:** Specialized Maintenance of Traffic (MOT) plans or roadway closure MOT plans must be submitted to the Brevard County Public Works Engineering Division (321) 633-2077 for approval a minimum of one week prior to the start of construction.

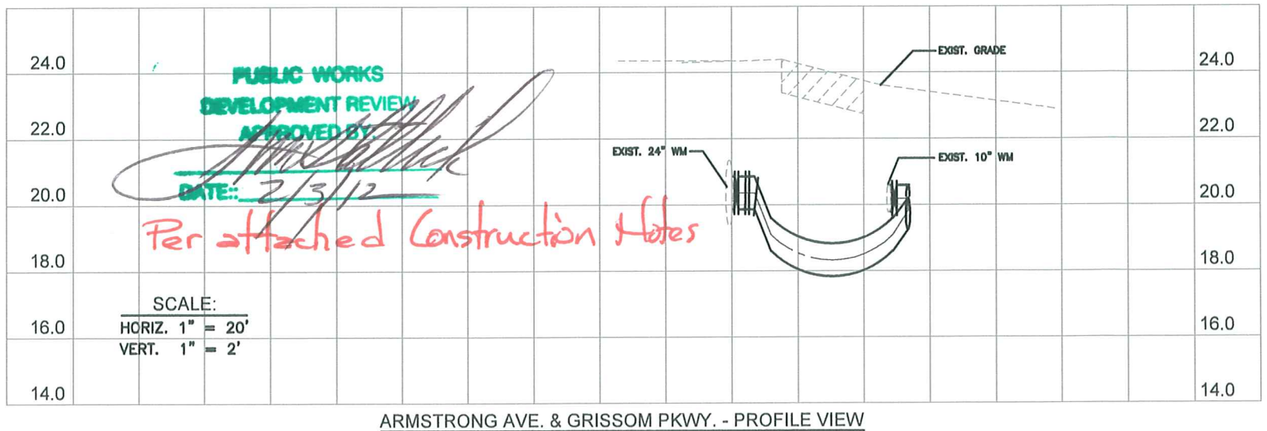
11. **Road Closures:** The contractor shall notify the Engineering Department one-week prior to any roadway closure. Road closures are not permitted until notification of the road closure can be sent to the Police Department, Fire Department, School Board, and other agencies. Road closure restrictions will be determined at the time the MOT plan is submitted. Any construction prior to the approval of the MOT plan will result in the Brevard County Permit being revoked.
    - Certain locations may require road closure to be preformed at night only.

12. **Lane Closures:** The contractor shall notify Brevard County Public Works Engineering Division (321) 633-2077 a minimum of two working days in advance of any lane closures associated with a Brevard County permit. Lane closures are not permitted until notification of the lane closure can be sent to the Police Department, fire Department, School Board, and other agencies. Lane closure restrictions will be determined at the time the MOT plan is submitted. Any construction prior to the approval of the MOT plan will result in the Brevard County Permit being revoked.
    - No lane closures will be permitted during peak hour traffic volumes.
    - Certain locations may require work in the right of way to be performed at night only.

13. **Mowing County R/W on Permitted Projects:** The Permittee/Contractor shall be responsible for mowing the County right of way within the limits of construction shown on the permitted plans. At no time shall the grass within the limits of construction exceed 12-inches in height. The Permittee/Contractor shall also be responsible for the maintenance of all drainage conveyance, drainage systems, erosion caused by the construction, and the maintenance of the required SWPPP. ***This only applies for large right of way projects, not for minor franchise utility permits.***



ARMSTRONG AVE. & GRISSOM PKWY. - UTILITY PLAN
SCALE 1" = 20'



PUBLIC WORKS
DEVELOPMENT REVIEW
APPROVED BY:
DATE: 2/3/12
Per attached Construction Notes

ARMSTRONG AVE. & GRISSOM PKWY. - PROFILE VIEW

CITY OF TITUSVILLE – GENERAL COORDINATION NOTES:

1. ALL UTILITY SYSTEM IMPROVEMENTS CONSTRUCTED IN THE CITY OF TITUSVILLE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE "CITY OF TITUSVILLE–TECHNICAL SPECIFICATIONS & DETAIL DRAWINGS" OR (COT–TSDD). THE LATEST EDITION AT THE TIME PERMITS ARE APPROVED SHALL BE EFFECTIVE FOR THE DURATION OF THE SUBJECT WORK OR PROJECT.
2. THE CITY OF TITUSVILLE GENERAL NOTES, SPECIFICATIONS AND STANDARD DETAILS INCLUDED WITHIN THESE PLANS ARE PROVIDED FOR THE CONVENIENCE OF FIELD PERSONNEL. THEY MAY NOT INCLUDE ALL REQUIREMENTS OF THE COT–TSDD. THE CONTRACTOR SHALL REFER TO THE FULL TEXT OF THE COT–TSDD FOR FURTHER DETAIL AND CLARITY WHEN NEEDED.
3. ANY REQUEST FOR VARIANCE OR NONCOMPLIANCE FROM THE COT–TSDD NOTED ABOVE MUST BE APPROVED BY THE SENIOR UTILITIES ENGINEER.
4. THE CONTRACTOR SHALL EXERCISE EXTREME CAUTION WHEN EXCAVATING IN CLOSE PROXIMITY TO WATER, WASTEWATER, RECLAIMED WATER AND OTHER UTILITY SYSTEMS. THE CONTRACTOR SHALL COORDINATE UTILITY LOCATIONS WITH RESPECTIVE UTILITY OWNERS AND CALL,"SUNSHINE ONE CALL", 811.
5. ACCIDENTAL DAMAGE TO CITY OF TITUSVILLE'S UTILITY SYSTEM: THE CONTRACTOR SHALL IMMEDIATELY NOTIFY AND REPORT DAMAGE TO THE CITY OF TITUSVILLE WATER RESOURCES, (NO MESSAGE) PHONE # (321) 383–5657 (WATER) OR (321) 383–5654 (SEWER).
6. IN EVENT OF DAMAGE TO UTILITY SYSTEM BY CONTRACTOR: THE CONTRACTOR SHALL IMMEDIATELY REPAIR ANY DAMAGE TO THE CITY OF TITUSVILLE UTILITY SYSTEM AS REQUIRED BY THE UTILITY OWNER AT CONTRACTORS COST. IN CASE OF UNRESPONSIVE ACTION BY THE CONTRACTOR, THE CITY RESERVES RIGHT TO REPAIR ANY DAMAGE. THE UNRESPONSIVE CONTRACTOR SHALL REIMBURSE THE CITY OF TITUSVILLE OF ALL REPAIR COST.
7. ADVANCE NOTIFICATION OF CONSTRUCTION: THE CONTRACTOR SHALL NOTIFY CITY OF TITUSVILLE, WATER RESOURCES INSPECTIONS, (321) 213–1954 AT 48 HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITY.
8. ADVANCE NOTIFICATION OF UTILITY CONNECTION: THE CONTRACTOR SHALL NOTIFY THE CITY OF TITUSVILLE, WATER AND SEWER OPERATIONS, (321) 383–5663, AT LEAST SEVEN DAYS IN ADVANCE TO SCHEDULE CONNECTIONS TO UTILITY SYSTEM.
9. UTILITY VALVE OPERATION: ONLY CITY OF TITUSVILLE UTILITY OPERATIONS PERSONNEL SHALL OPERATE VALVES AND FIRE HYDRANTS. THE CONTRACTOR, WHEN NEEDED, SHALL CALL THE CITY (321) 383–5663, TO REQUEST VALVE OPERATIONS AT LEAST TWO (2) DAYS IN ADVANCE OF CONSTRUCTION WORK.
10. OPERATIONS INVOLVING WATER OR WASTEWATER FACILITIES INCLUDING PUMPING STATIONS: THE CONTRACTOR SHALL COORDINATE AT LEAST TWO (2) WEEKS IN ADVANCE, ANY CONSTRUCTION OPERATION THAT MAY REQUIRE THE MANUAL OPERATION OR INTERUPTION OF A FACILITY. THE CITY WILL PROVIDE PERSONNEL TO OPERATE THE CITY FACILITIES.
11. REQUIRED TESTING BY CONTRACTOR: THE CONTRACTOR SHALL NOTIFY THE CITY OF TITUSVILLE (321) 383–5666, AT LEAST TWO (2) DAYS PRIOR TO SAMPLING ACTIVITIES FOR PURPOSE OF TESTING AS REQUIRED BY THE CITY. THE CONTRACTOR SHALL NOT TEST OR SAMPLE WITHOUT OBSERVATION BY CITY INSPECTION PERSONNEL.
12. TEMPORARY OR CONSTRUCTION WATER SERVICE CONNECTIONS PROVIDED BY FIRE HYDRANT CONNECTION: THE CITY WILL PROVIDE A METER ON FIRE HYDRANT CONNECTION. THE CONTRACTOR SHALL PROVIDE NON–REFUNDABLE ACCOUNT INITIATION FEE, A REFUNDABLE SECURITY DEPOSIT FOR THE METER APPARATUS AND PAY ALL COST FOR WATER USED.
13. THE CONTRACTOR SHALL COMPLY WITH ALL CONDITIONS AND REQUIREMENTS OF THE BREVARD COUNTY RIGHT–OF–WAY PERMIT INCLUDING MAINTENANCE OF TRAFFIC REQUIREMENTS. THE MAINTENANCE OF TRAFFIC SHALL COMPLY WITH FDOT SECTIONS 600 and 611, 612, 613 AS APPLICABLE.

UTILITY OWNER LIST

UTILITY OWNER	TELEPHONE NUMBER
CITY OF TITUSVILLE - WATER RESOURCES	(352) 527-7650
WATER OPERATIONS	(352) 527-5446
SEWER OPERATIONS	(600) 700-8744
INSPECTIONS	(352) 315-8528
CITY OF TITUSVILLE ENGINEERING	(800) 554-6427
CITY OF TITUSVILLE - ENGINEERING	(813) 862-0522
	(352) 368-8763
FLORIDA POWER & LIGHT	(352) 489-3394
	(352) 628-3740
AT & T SOUTHEAST	
BRIGHTHOUSE CABLE	
FLORIDA CITY GAS	
FLORIDA CITY GAS	(352) 527-1898
	(352) 795-4382
	(800) 432-4770 OR 811

PUBLIC WORKS
FEB - 1 2012
ENGINEERING

City of Titusville
2836 Garden Street
Titusville, Florida 32796
Ph: (321) 383-5667 Fax: (321) 383-5653

ARMSTRONG AVE. & GRISSOM PKWY. - UTILITY PLAN
Sheet

811 Know what's below. Call before you dig.

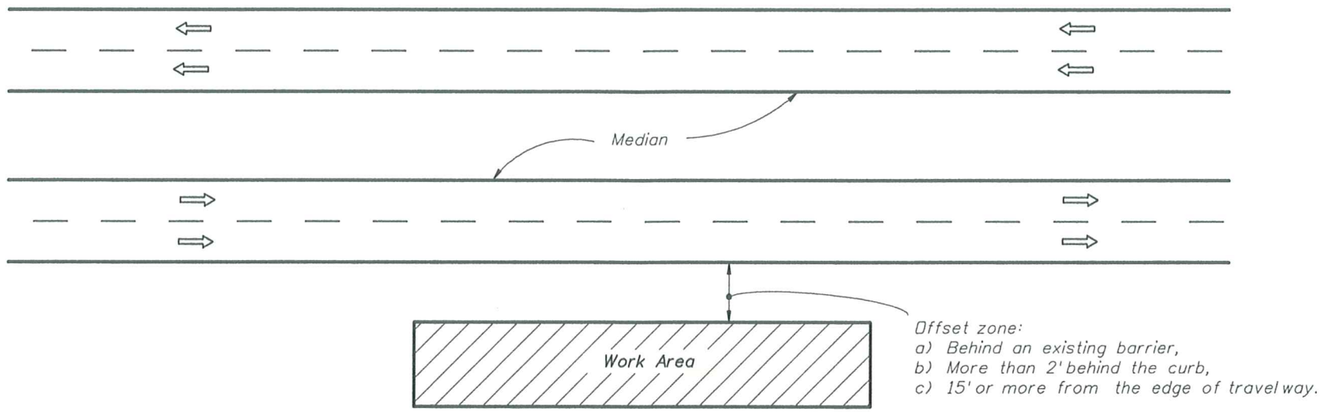
No.	REVISION	DATE

ARMSTRONG WSF MODIFICATIONS
Project

WATER RESOURCES ENGINEERING (Dept.)	1
ARMWSF B (Dwgf)	
JAN 6, 2012 (Date)	
1" = 20' (Scale)	(Sheet)

NOT FOR CONSTRUCTION
FOR BIDDING PURPOSES ONLY

Edward C. Wardingley, P.E.
FL License # 58803


Median
Work Area
Offset zone:
a) Behind an existing barrier,
b) More than 2' behind the curb,
c) 15' or more from the edge of travelway.

GENERAL NOTES

1. If the work operation (excluding establishing and terminating the work area), requires that two or more work vehicles cross the offset zone in any one hour, traffic control will be in accordance with Index No. 612.
2. No special signing is required.
3. This index also applies when work is being performed on a multilane undivided highway.
4. This index also applies to work performed in the median behind an existing barrier or more than 15' from the edge of travel way, both roadways. Work performed in the median behind curb and gutter shall be in accordance with Index No. 612.
5. When a side road intersects the highway within the work area, additional traffic control devices shall be placed in accordance with other applicable TCZ Indexes.
6. When construction activities encroach on a sidewalk, refer to Index No. 660.
7. For general TCZ requirements and additional information, refer to Index No. 600.

SYMBOLS

Work Area

Lane Identification + Direction of Traffic

CONDITIONS

WHERE ANY VEHICLE, EQUIPMENT, WORKERS AND THEIR ACTIVITIES ARE BEHIND AN EXISTING BARRIER, MORE THAN 2' BEHIND THE CURB, OR 15' OR MORE FROM THE EDGE OF TRAVEL WAY.

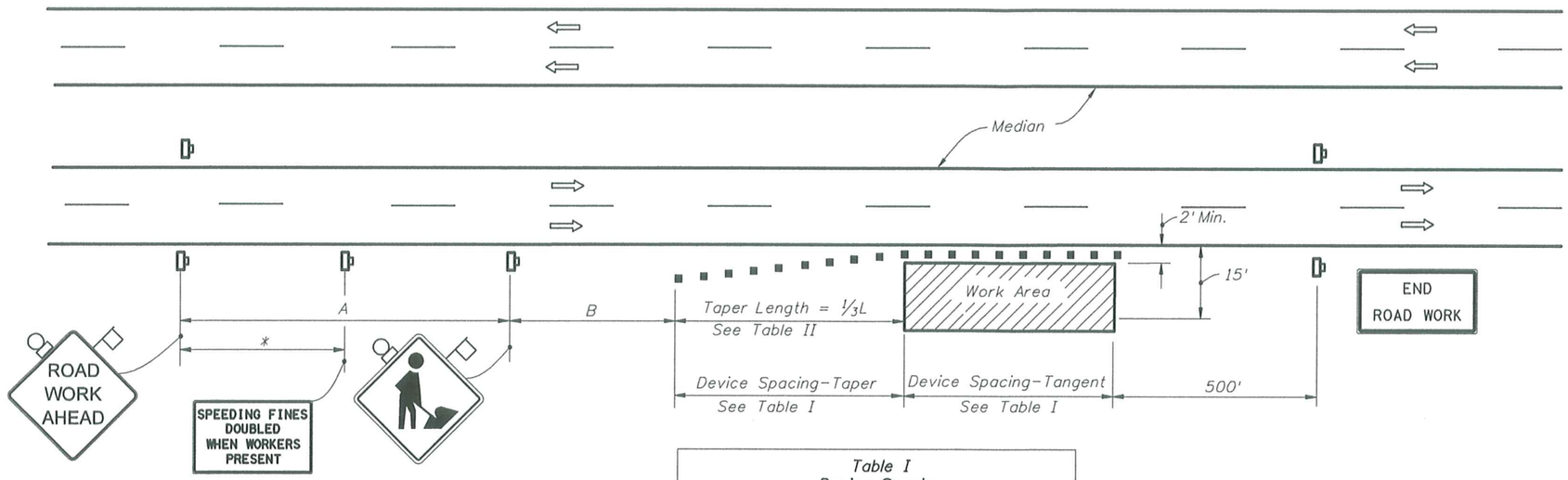
STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

2010 FDOT Design Standards

MULTILANE, WORK OUTSIDE SHOULDER

Last Revision	Sheet No.
07/01/05	1 of 1

Index No. 611



DISTANCE BETWEEN SIGNS		
Speed	Spacing (ft.)	
	A	B
40 mph or less	200	200
45 mph	350	350
50 mph or greater	500	500

* 500' beyond the ROAD WORK AHEAD sign or midway between signs whichever is less.

SYMBOLS

Work Area

Sign With 18"*18" (Min.) Orange Flag And Type B Light

Channelizing Device (See Index No. 600)

Work Zone Sign

Lane Identification + Direction of Traffic

Table I Device Spacing				
Speed (mph)	Max. Distance Between Devices (ft.)			
	Cones or Tubular Markers		Type I or Type II Barricades or Vertical Panels or Drums	
	Taper	Tangent	Taper	Tangent
25	25	50	25	50
30 to 45	25	50	30	50
50 to 70	25	50	50	100

GENERAL NOTES

1. If the work operation encroaches on the through traffic lanes or when four or more work vehicles enter the through traffic lanes in a one hour period (excluding establishing and terminating the work area), a flagger shall be provided and a FLAGGER sign shall be substituted for the WORKERS sign. The flagger shall be positioned at the point of vehicle entry or departure from the work area.
2. This TCZ plan also applies to work performed in the median more than 2' but less than 15' from the edge of travelway.
3. When work is being performed on a multilane undivided roadway the signs normally mounted in the median (as shown) shall be omitted.
4. WORKERS signs to be removed or fully covered when no work is being performed.
5. SHOULDER WORK sign may be used as an alternate to the WORKER symbol sign.
6. When a side road intersects the highway within the TTC zone, additional TTC devices shall be placed in accordance with other applicable TCZ Indexes.
7. For general TCZ requirements and additional information, refer to Index No. 600.

DURATION NOTES

1. Signs and channelizing devices may be omitted if all of the following conditions are met:
   a) Work operations are 60 minutes or less.
   b) Vehicles in the work area have high-intensity, rotating, flashing, oscillating, or strobe lights operating.

Table II Taper Length – Shoulder				
Speed (mph)	1/3L (ft.)			Notes
	8' Shldr.	10' Shldr.	12' Shldr.	
25	28	35	42	$L=\frac{WS^2}{60}$
30	40	50	60	
35	55	68	82	
40	72	90	107	
45	120	150	180	L=WS
50	133	167	200	
55	147	183	220	
60	160	200	240	
65	173	217	260	
70	187	233	280	

8' minimum shoulder width.

1/3L = Length of shoulder taper in feet

W = Width of total shoulder in feet (combined paved and unpaved width)

S = Posted speed limit (mph)

CONDITIONS

WHERE ANY VEHICLE, EQUIPMENT, WORKERS OR THEIR ACTIVITIES ENCROACH THE AREA CLOSER THAN 15' BUT NOT CLOSER THAN 2' TO THE EDGE OF TRAVEL WAY.

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

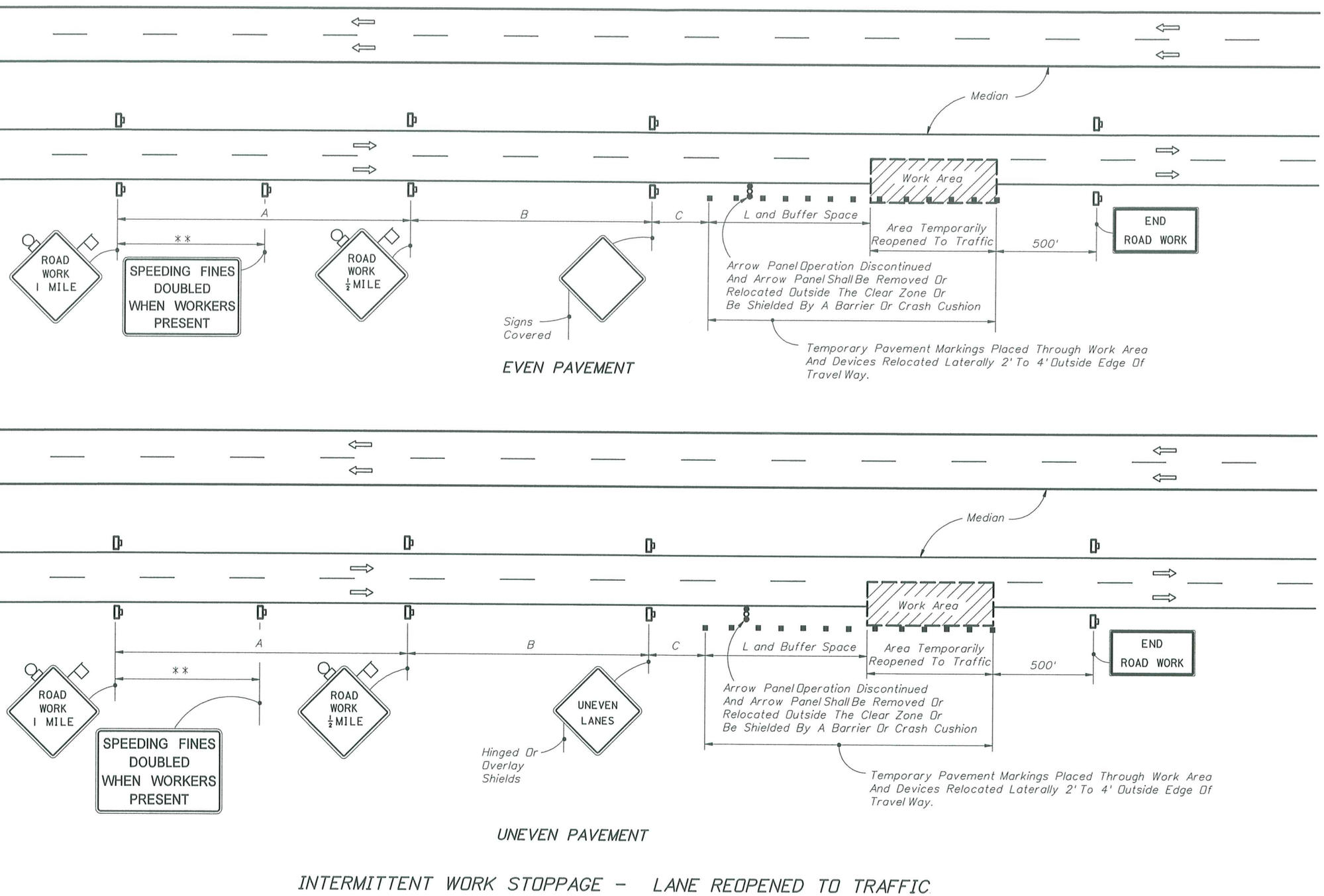
2010 FDOT Design Standards

MULTILANE, WORK ON SHOULDER

Last Revision 07/01/07

Sheet No. 1 of 1

Index No. 612



EVEN PAVEMENT

UNEVEN PAVEMENT

INTERMITTENT WORK STOPPAGE - LANE REOPENED TO TRAFFIC

2010 FDOT Design Standards

MULTILANE, WORK WITHIN THE TRAVEL WAY MEDIAN OR OUTSIDE LANE

Last Revision	Sheet No.
07/01/05	2 of 2

Index No. 613

RECEIPT

BREVARD COUNTY
2725 JUDGE FRAN JAMIESON WAY
VIERA, FL 32940

Application: 12RW-00110
Application Type: Development/Row/NA/NA
Address: GRISSOM PKWY, VIERA, FL

Receipt No.: 306964

Payment Method	Ref Number	Amount Paid	Payment Date	Cashier ID	Comments
Check	91153	$375.00	02/03/2012	JOYCE.DRUMM	

Owner Info.: CITY OF TITUSVILLE / JANET ELROD
2836 GARDEN STREET
TITUSVILLE, FL 32796

Work Description: 1- 10" DIRECTIONAL BORE (60LF) UNDER GRISSOM PKWY N. OF ARMSTRONG DR., TITUSVILLE, 32796

Invoice #	Invoice Date	Period	Fee Item	Fee
303211	03-Feb-12	FINAL	Directional Bore	$375.00
			Subtotal:	$375.00
			Total Fee:	$375.00

***Note: Additional Fees may apply to obtain a Certificate of Completion, a Certificate of Occupancy, or a Final Building Inspection. Please call the Central Cashier to verify.**

Contact Numbers
Building Dept. – 633-2072, Central Cashier – 633-2068, Code Enforcement – 633-2086, Land Development – 633-2065, Licensing, Regulation, and Enforcement – 633-2058

BREVARD COUNTY RIGHT-OF-WAY/EASEMENT PERMIT APPLICATION

To be completed by Land Development Division:

Date Received: 2/1/12 Fee: 375 Reviewed by:

Concurrency Y/N (Initials) _____ Send to: ☐ ED ☐ RB ☐ ST ☐ TE ☐ TR ☐_____ ☐_____

Review Days: ☐ 15 ☐ 8 ☐ _____ *** Will a Performance and Maintenance Bond be required? ☐ Yes ☐ No**

☑ Approved for Permitting Permit # 12RW-00110 Date Permitted: 2/3/12

Print clearly or type application

Property Owner / Applicant / Franchise Owner Information:

First: CITY OF TITUSVILLE-Water Resources Deptartment M.I.: _____ Last: _____ Suffix: (Sr., Jr.) _____

Address: 2836 GARDEN STREET Apt. / Suite #: _____

City: TITUSVILLE State: FL Zip Code: 32796

Phone Number: (321) 383-5668 Fax Number: (321) 383-5653

Contractor Information (If other than owner/applicant):

Company Name: CITY OF TITUSVILLE-Water Resources Dept. Contact: Janet Elrod

License # _____ Address: 2836 GARDEN STREET Apt. / Suite #: _____

City: TITUSVILLE State: FL Zip Code: 32796

Phone Number: (321) 383-5668 Fax Number: (321) 383-5653

PUBLIC WORKS ENGINEERING FEB – 1 2012

Project Information:

Tax Acct. #: _____ Site Address: Grissom Parkway at Armstrong Drive Zip Code: 32781

Description of work to be done:

Install a 10-inch connection (approx. 60 L.F.-12" HDPE directional drill) between the existing 10-inch water main and existing 24-inch water main, all located at the intersection (in Public R/W) of Grissom Pkwy. and Armstrong Drive.

SCHEDULE OF FEES REQUIRED AT THE TIME OF SUBMITTAL

Please make checks payable to: Brevard County Board of County Commissioners.

QUANTITY	TYPE (Residential Improvements)	FEE	TOTAL
	Residential Driveway (Permanent & Temporary, per each connection)	$ 90.00	
	Revision Review to an approved driveway plan	$ 15.00	
	Easement Encroachments (other than driveways)	$ 90.00	
	Work Commencing without a permit	Double the permit fee	
	Re-Inspection Fee	$ 60.00	
Commercial Projects - Review and Inspection Fees for projects with construction costs below $200,000.00 (not associated with a single family residence) *See page 2 for Fees for Commercial Projects above $200,000.00.			
	Storm Sewer Construction	$125.00	
	Stormwater Discharge	$300.00	
	Sidewalk Construction	$125.00	
	Commercial Driveway (Permanent & Temporary, per each connection)	$500.00	
	Engineering Revision Review to an active permit	$ 25.00	
	Paved Road Open Cut, per each cut	$750.00	
	Jack & Bore/Directional Bore, per each (all approved tunneling methods)	$375.00	$375.00
	Utility Open Pits including short side service connections	$ 75.00	
	Roadway/Intersection improvements (turn lanes and signals, misc. median work), in addition to commercial driveway fee	$500.00	
	Right-of-Way utilization fee (underground or aerial)	$125.00 + $.29 a foot	
	Residential or Commercial GRAND TOTAL		375

Commercial Projects - Review and Inspection Fees for projects with construction costs above $200,000.00 (not associated with a single family residence)		
Permit application fees for right-of-way and/or easement improvement projects (requires engineer's certified cost estimate.		
Inspection fees for projects are required prior to the issuance of the right-of-way easement permit and are calculated as follows and are cumulative until the estimated cost is reached.		
Of the first (up to) $500,000.00	2%	
Of the next $500,000.00	1.5%	
Of the amount over $1,000,000.00	1%	

Checklist for Required Information and Exhibits

PRIVATE IMPROVEMENTS (SINGLE FAMILY RESIDENCES)

- ☐ 3 (three) copies of detailed drawings depicting the location of the proposed improvements within the Right-of-Way or Easement drawn and dimensioned on a survey or plot plan. When a culvert pipe is being installed or already exists then a certified survey or plot plan by a Certified Surveyor or Registered Engineer is required.
- ☐ Owner's Authorization to Act as Applicant form
- ☐ When a culvert/drainage pipe is needed under the driveway, the following information **must** be shown on the certified survey/plot plan:
  - Location, size, and material of the new culvert/drainage pipe and the proposed invert elevations
  - Existing culvert sizes, pipe material, end treatment, and invert elevations of all driveways within 500' upstream and downstream of the proposed location of the new culvert/drainage pipe
  - Distances from the existing adjacent culvert/drainage pipes to the proposed location of the new culvert/drainage pipe
  - Centerline of swale elevations on each side of the driveway

DRIVEWAY APRON WIDTH: _____ (12 Feet Minimum, 24 Feet Maximum)

DRIVEWAY APRON PLACEMENT TO NEAREST PROPERTY LINE: ☐ 5 Feet (Minimum) Other _____

DRIVEWAY APRON TO BE CONSTRUCTED OF: ☐ Marl / Shell (dirt road only) ☐ Asphalt ☐ Concrete ☐ Pavers

(Homeowner will be responsible for repair and maintenance of Driveway materials in the Right-of-Way and the sidewalk area within the driveway)

DRAINAGE RUN-OFF IS BY: ☐ Curb/Gutter ☐ Ditch ☐ Swale ☐ Other_____

COMMERCIAL IMPROVEMENTS AND INCORPORATED SUBDIVISIONS

- ☒ Proposed M.O.T. (Maintenance of Traffic attached to each set of plans)
- ☒ Five copies of detailed drawings depicting the location of the proposed improvements within the Right-of- Way or Easement drawn and dimensioned on a survey or plot plan by a Certified Surveyor or Registered Engineer
- ☐ **Approved** Concurrency Form from Brevard County Planning and Zoning Office
- ☐ Owner's Authorization to Act as Applicant Form
- ☐ 2 sets of Stormwater Calculations, if applicable N/A
- ☐ If property has been annexed within the past three years, provide copy of Recorded Annexation documents. N/A

Statement of Accuracy:

I hereby confirm that the above information is true and correct and I assume all responsibility for the truth and validity of this application and associated exhibits submitted herewith.

Janet Elrod 1-31-12

Applicant's Signature **Authorized Representative (If applicable)** **Date**

JANET ELROD, UTILITY ENGINEERING MANAGER

Please Print Applicants or Authorized Representative's Name

June 8, 2007
Revised March 10, 2009
Revised July 16, 2010
Revised August 13, 2010
Revised August 26, 2010

PROPOSAL 07-124

INSTALL ONE 16-INCH INLET PIPE

3.5-MG WATER STORAGE RESERVOIR
CITY OF TITUSVILLE
BREVARD COUNTY, FL

Crom Engineering and Construction Services, Inc. (CECS) proposes to provide labor and material for the modification of the prestressed concrete tank in accordance with all applicable codes and standards including OSHA and AWWA, ACI and standard prestressed concrete tank design.

1. DRAWINGS, SPECIFICATIONS, AND OTHER REQUIRED DATA

   Prior to starting work, Crom Engineering and Construction Services, Inc. will gather all data required for submittal purposes for the modifications to the aforementioned storage tank including any available computations, detailed drawings, and specifications.

2. COMMENCEMENT AND COMPLETION

   Upon your execution of this proposal, we will be prepared to start work **three weeks** after approval of our shop drawings; and will undertake to furnish sufficient labor, materials, and equipment to complete the work within approximately **one week** working time thereafter.

   In the event that we cannot start the job by **March 1, 2011** because of delays of any nature which are caused by the owner or other contractor employed by him or other circumstances over which we have no control, the contract price then may be renegotiated to reflect any increased costs.

3. INSURANCE

   We hereby certify that we have complete Workers' Compensation Insurance, and that we carry adequate Liability and Property Damage Insurance as well as Builders' Risk Insurance. A certificate will be furnished by our insuring agency upon request.

4. SERVICES TO BE FURNISHED BY CROM ENGINEERING AND CONSTRUCTION SERVICES, INC.

We propose to furnish all supervision, labor, material, equipment, scaffold and forms required to complete the work, except as noted in Paragraph 5. The services to be furnished by Crom Engineering and Construction Services, Inc. are specifically:

a. Provide and install one 20-inch stainless steel wall sleeve and link-seals units for the addition of a 16-inch DIP inlet pipe. Wall sleeve shall be installed in the unbanded area of the wall at the center elevation of the manhole.

b. Provide and install one 16-inch DIP FL-FL inlet pipe (one side hand tight), one 16-inch DIP flanged base bend (90°), one 16-inch DIP FL-FL riser pipe, and one 16-inch DIP flange and flare starting approximately 2'-9" outside of the tank with the center line of the riser approximately 5'-0" inside the tank rising 34'-0" high from tank floor.

c. Provide and install 16-inch DIP FL-FL Butterfly Valve on exterior side of wall pipe.

d. Install 1 concrete pipe support pedestal.

e. Provide and install (4) stainless steel pipe brackets to the new 16" riser pipe to include installation of concrete boss at each bracket connection to the interior tank wall.

f. Erect and dismantle scaffold for the installation of the riser pipe and pipe brackets.

This work shall be performed on the following tank:

- 3,500,000 Gallon Water Storage Reservoir
  130'-0" ID x 35'-3" SWD
  (Crom Job No. 9529)

5. MATERIALS AND SERVICES FURNISHED BY OTHERS

It is understood that the following services shall be provided by others without expense to Crom Engineering and Construction Services, Inc.

a. Adequate access to the tank site including open storage space for our vehicles, equipment and materials, conveniently located near the tank to be modified.

b. A continuous supply of potable water under minimum pressure for the use of the CECS crew within 100 feet of the tank site.

c. A continuous supply of electricity during the period of work: one 30-AMP, 110-volt service for the operation of our power tools and accessories, located not more than 100 feet from the tank. Please be sure that all circuit breakers are ground-fault protected.

d. Any permit or other governmental fees as may be required for the work.

e. Drainage and disposal of the tank's contents.

f. Disinfection and refilling of the tank's contents.

g. Any yard piping connecting to the tank is to be provided by others.

h. Cleaning the interior and exterior of the tank and accessories.

i. Repair and remediation of the tank and accessories.

j. Complete lock out and tag out of the subject tank prior to personnel entering the tank. Owner will be required to provide all materials for this process. Crom Engineering and Construction Services, Inc. will review the procedures before entering the tank.

6. BACK CHARGES AND CLAIMS FOR EXTRAS

No claim for extra services rendered or materials furnished will be valid by either party unless written notice thereof is given during the first ten days of the calendar month following that in which the claim originated. Crom Engineering and Construction Services, Inc.'s claims for extras shall carry 30% for overhead and 10% for profit.

7. DELAYS

It is agreed that we shall be permitted to prosecute our work without interruption. If delayed at any time for a period of 24 hours or more by an act or neglect of the owner, his representative, or other contractor employed by him, or by reason of any changes ordered in the work, we shall be reimbursed for our actual additional expense caused by such delay, including loss of use of our equipment, plus 30% for overhead.

8. LABOR

This proposal is predicated on open-shop labor conditions, using our own personnel. If we are required to employ persons of an affiliation desirable to the owner or other contractor employed by him or the general contractor thereby resulting in increased costs to us, the contract price shall be adjusted accordingly. Such requirement shall not provide that Crom Engineering and Construction Services, Inc. sign a contract with any labor organization. In the event of a labor stoppage, we shall not be in default or be deemed responsible for delay of the progress of this contract or damage to the owner or the contractor so long as Crom Engineering and Construction Services, Inc. has sufficient qualified employees available to perform the work.

9. QUOTATION

We are prepared to carry out this work in accordance with the foregoing for the lump sum price of:

Provide and install 16" DIP Inlet pipe:

Final payment, including any retention, shall be made within **30 days** from the time work is completed or the billing is received, and is to be received by us in our accounting office at 250 SW 36th Terrace, Gainesville, Florida 32607. Final payment shall not be held up because of delays in testing. Owner shall pay CECS interest at 12% per annum on any overdue amounts.

10. CONSULTATION AND LIMITATIONS

If the Owner wishes to have CECS to perform any additional repairs or remediation of the tank or accessories, it shall authorize such work in writing and pay CECS its standard charges for such work.

It is agreed that CECS shall not be responsible for any consequential, special or delay damages.
It is agreed that the venue for any litigation under this Agreement shall be in Alachua County, Florida.

If CECS engages an attorney for the collection of the amounts due from the Owner, the Owner shall pay CECS its reasonable attorney's fees and costs through any appeal.

11. GUARANTEE

CECS will guarantee its workmanship and materials on its work covered in this Proposal for a period of one year after completion of its work. Prior to leaving the location, CECS personnel will perform a walk through with the responsible party overseeing our work for the Owner or Contractor. In case any defects in CECS' workmanship or materials appear within the one-year period after completion of CECS' work, CECS shall promptly make repairs at its own expense upon written notice by the Owner or Contractor that such defects have been found.

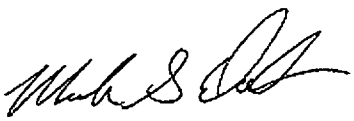
CECS' guaranty is limited to defects in CECS' workmanship and materials and CECS is not responsible for ordinary wear and tear or for damage resulting from negligent or inappropriate use.

12. ACCEPTANCE

This proposal is offered for your acceptance within **45** days from the proposal date. We reserve the right after that period to amend our bid to reflect our changing construction schedules and materials and labor rate changes. The return to this company of a copy of this proposal with your acceptance endorsed thereon within the time aforesaid will constitute a contract between us. This proposal shall be made a part of any subcontract agreement or purchase order.

Sincerely,

CROM ENGINEERING & CONSTRUCTION SERVICES, INC.



Mark S. Dalton
Project Manager

/kd

ACCEPTED

_____

BY: _____

TITLE: _____

DATE: _____

CITY OF TITUSVILLE

WATER RESOURCES DEPARTMENT

TECHNICAL SPECIFICATIONS

FOR THE INSTALLATION OF

DOMESTIC WATER SUPPLY MAINS

CIP PROJECT VERSION

INDEX

SECTION 1 *GENERAL* 1
SECTION 2 *PLANS PREPARATION (Not applicable to CIP Contracts)* 1
SECTION 3 *DESIGN AND CONSTRUCTION STANDARDS* 3
SECTION 4 *SEPARATION OF WATER AND SEWER LINES* 5
SECTION 5 *MATERIALS FOR PIPES, FITTINGS AND VALVES* 6
SECTION 6 *PIPE INSTALLATION* 14
SECTION 7 *FINAL ACCEPTANCE BY THE CITY……..…17*

Revisions

1. GENERAL

1.1. These specifications cover the design, review of plans and specifications, applicable fees, installation, inspection, testing, and acceptance of water distribution systems, water main extensions and all appurtenant items which are to be owned and maintained by the City of Titusville.

1.2. All improvements and modifications made to the Titusville Municipal Water System shall be completed in accordance with the City approved site plans. Material and workmanship shall conform to the specifications that appear in this document.

1.3. The Contractor shall not remove any thrust blocks or mechanical restraint joints, connect to any water mains, or operate water control valves, except under the direct observation of the City Inspector. NO WORK SHALL BEGIN UNLESS THE CITY HAS BEEN NOTIFIED AT LEAST 48 HOURS IN ADVANCE.

1.4. Unless otherwise noted or approved by the City of Titusville Water Resources Department (CoTWRD), all materials shall be manufactured in the United States.

1.5 All underground utility work shall be performed by a licensed Underground Utility Contractor licensed in the State of Florida.

2. PLANS PREPARATION

2.1. All water distribution systems, water main extensions and all appurtenant items shall be designed in accordance with the applicable regulations of the City, the Florida Department of Environmental Protection, and the standards established herein. In addition, all water distribution systems and water main extensions shall be designed and constructed for a serviceable life of not less than 50 years.

2.2. The City of Titusville shall own and maintain all portions of the water system up to and including the water meter, and shall operate and maintain the backflow preventer. For fire lines, City ownership ends at the fire line control valve.

2.3. No water distribution system or water main extension or any portion thereof which is to become the property and sole responsibility of the City of Titusville will be designed or constructed outside of any public right-of-way and/or easement which may be used for said purpose.

2.4. The water distribution system and/or water main extensions shall be designed and constructed in accordance with the fire protection requirements as approved by the Fire Marshall.

2.5. LOCATION: Mains shall be located within dedicated rights-of-way or utility easements.

a. Rights-of-way: Mains shall maintain a consistent alignment with respect to the centerline of the road. In residential developments, mains should be installed as illustrated on the City's "Utility Placement Within a 50' Public Road Right-of-Way" detail. Exceptions will be made on a case-by-case basis. In all cases, mains shall be installed along one side of the road, with crossings kept to a minimum.
b. Easements: If piping is constructed within an easement, the centerline of the pipe shall be located within two (2) feet of the centerline of the easement. Mains and

easements shall not be placed under buildings, retention ponds, courts, swimming pools, fountains or other structures. Placement of mains under pavement shall be kept to a minimum. Placement of mains along interior side or rear lot lines or stormwater retention pond berms is strongly discouraged. Exceptions may be allowed on a case-by-case basis if such configuration results in efficient placement and utilization of the system as determined by the CoTWRD. Services, air release valves, and other valves shall not be placed along interior side or rear lot lines or stormwater retention pond berms. The minimum water line easement width shall be fifteen (15) feet. Additional easement widths may be required on a case-by-case basis.

c. Foundations: All water mains up to eight (8) inches in size shall be located at least ten (10) feet from any building foundation. Water mains greater than eight (8) inches shall be located at least fifteen (15) feet from any building foundation.

2.6. SIZING WATER SERVICE LINES AND METERS: Sizing of water service lines and meters shall be per American Water Works Association “Manual of Water Supply Practices, Sizing Water Service Lines and Meters, AWWA M22”, latest edition.

2.7. FIRE HYDRANT SPACING AND LOCATION: Fire hydrants in single-family residential areas shall be located so that they are not over 500 feet apart (as measured along a street) and shall be connected to water mains no less than six (6) inches in diameter and to looped water mains whenever possible. Dead end streets or cul-de-sacs shall not have a length greater than 200 feet from the nearest fire hydrant. Fire hydrants in commercial (business, industrial, institutional, and apartment) districts shall be located so that they are not over 250 feet part (as measured along a street) and shall be connected to water mains no less than eight (8) inches in diameter and to looped water mains whenever possible. All fire hydrant and fire line requirements shall be reviewed and approved by the Fire Marshall.

2.8. AVERAGE DAILY FLOW: Average daily water flow shall be calculated by referencing the equivalent residential connection (ERC) flow rates as outlined in “Code of Ordinances City of Titusville, Florida, Land Development Regulations Section 63-133”. Maximum daily water flow shall be calculated as two (2) times the average daily water flow, and the peak hourly flow shall be calculated as four (4) times the average daily water flow.

2.9. FIRE FLOW REQUIREMENTS: All residential fire hydrants are to be designed to operate at a minimum of 1,000 gpm at 20 psi from the farthest fire hydrant at the initial point of connection to the residential development. Commercial and Industrial fire flow requirements shall be determined in accordance with the applicable local fire department codes and/or ISO standards. Where fire flow requirements exceed the anticipated available fire flow from the central water system, an on-site fire protection system, or other fire department approved mitigation, shall be utilized.

2.10. DESIGN CALCULATIONS: The Project Engineer shall submit signed, sealed and dated design calculations with the plans for all water distribution projects. Calculations shall show that the water mains will have sufficient hydraulic capacity to transport peak hourly flows and the combination of maximum daily flows and fire flows while meeting the requirements of sections 2.12. Head losses through meters and backflow devices shall also be included in the calculations.

2.11. PRESSURE: All water mains shall be designed in accordance with Section 2.10 above. The system shall be designed to maintain a minimum pressure of 20 psi at all points in

the distribution system under all conditions of flow. Higher pressures may be required at commercial, industrial and high-density residential areas. The design pressure within the system should be verified with the CoTWRD prior to beginning any calculations. For excessive pressures, pressure reducing provisions may be required.

2.12. DESIGN FRICTION LOSS: Friction losses through mains shall be based on the Hazen and Williams formula. In the use of the Hazen and Williams formula, the value for "C" shall be 120 for ductile iron pipe and 130 for PVC and HDPE pipe. "C" values greater than 130 shall not be allowed.

2.13. FDEP: The developer shall submit the following:

a. Two (2) signed and sealed sets of plans, calculations and specifications.
b. A CD containing the plans in 300 dpi Tiff format and calculations and specifications in Adobe pdf format.
c. Two (2) executed Florida Department of Environmental Protection (FDEP) permit applications.
d. Appropriate filing fees.

3. DESIGN AND CONSTRUCTION STANDARDS

3.1. POTABLE WATER: All pipe and fittings for potable water distribution shall be ductile iron or polyvinyl chloride pipe (PVC). Refer to Section 5.1, 5.2 & 5.3. HDPE (DR11), or City approved equal, can be approved for use on a case-by-case basis by the CoTWRD for directional boring purposes only.

3.2. VALVES: All valves will meet or exceed all requirements of AWWA C-509 Standards, latest revision. All valves shall be resilient wedge gate valves. All valves larger than 12 inches, except tapping valves, shall have bevel gears with side actuators for horizontal installation.

3.3. TEST AND INSPECTION

3.3.1. Laboratory or Plant test: Pipe and materials shall be tested in accordance, and for conformity, with the latest editions of the following:

ITEM	SPECIFICATIONS
Ductile iron fittings	ANSI 121.10 (AWWA C-111)
Ductile iron pipe	ANSI A21.51 (AWWA C-151)
Polyethylene Encasement	ANSI A21.5 (AWWA C-105)
Polyvinyl Chloride Pipe (PVC) 4" & Larger	AWWA C-900/DR-18 or C-905/DR-18
Copper Pipe 3/4" – 2"	Type "K" soft copper
EndoTrace Blue Poly 2"	AWWA C901
Gate valves larger than 2"	Resilient seated AWWA C-509
Gate valves 2" & smaller	Fed. Spec. WW-V-54 (r.5.3.6)

3.3.2. The Contractor shall obtain from the pipe manufacturer, and *submit to the City*, *a certificate of inspection* stating that the materials furnished have been inspected at the plant, meet the requirements of these specifications, and that the pipe is marked in accordance with Section 5.1.

3.3.3. The entire product of any manufacturer may be rejected when, in the opinion of the City, the methods of manufacture fail to secure uniform results acceptable to the requirements of these specifications.

3.3.4. All pipe, valves and fittings shall be subject to *inspection at time of delivery* and also in the field, just *prior to installation*. All pipe, valves or fittings which, in the opinion of the City, do not conform to these specifications, will be rejected and shall be removed by the Contractor at his expense.

3.3.5. Hydrostatic and Leakage Testing:

3.3.5.1. All pipe installed for the purpose of conveying potable water under pressure shall be tested after installation in accordance with the applicable portions of the hydrostatic tests as set forth in the latest revision of Section 5 of AWWA Standard C600 for ductile iron mains and Section 7.3 of AWWA Standard C605 for PVC mains, with leakage limited to the following schedule:

(All water line installations must maintain a leakage rate of less than the following leakage per thousand feet of main):

TABLE I
ALLOWABLE LEAKAGE PER 1,000 FT. OF PIPE (G.P.H.)

Test Pressure (psi)	Nominal Pipe Diameter									
	4”	6”	8”	10”	12”	14”	16”	18”	20”	24”
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99

The maximum length of water main to be pressure tested shall be limited to 2,000 linear feet of main, sectioned by control valves in the closed position. More than one section may be tested simultaneously. All service lines and appurtenances shall be tested at the time the main is tested.

3.3.5.2. All water lines shall be tested to 150 psi test pressure for two (2) hours duration. All pumps, gauges, and appurtenances necessary shall be furnished by the Contractor. All leaks shall be repaired by removing and replacing defective pipe and joints with pipe and joints that are free of defects, after which the lines shall be retested. Such repair and retesting shall be done until the lines pass the specified retest.

3.3.5.3. Contractors are required to pressure test all lines prior to scheduling the verification test witnessed by the City Inspector. If the test fails with the City Inspector present, the contractor shall be required to pay a retest fee of $50 to the City of Titusville, prior to the required retest.

3.3.5.4. All valves, hydrants, and services shall be hydrostatically tested and disinfected with the line in which they are installed.

3.3.6. Disinfection - Bacteriological Testing:

3.3.6.1. All water pipe, fittings and valves on potable water lines shall be thoroughly disinfected prior to being placed in service. Disinfection shall follow the applicable provisions of the procedure established as set forth in AWWA C-651, latest revision. Samples of water shall be collected by a representative of a State Certified Testing

Laboratory, with a City Inspector present, from fittings provided by the Contractor for that purpose. Disinfection shall be repeated until the piping system passes the City requirements, with a minimum of 75 ppm chlorine content at each test point, verified by the City Inspector.

3.3.6.2. Flows for chlorination purposes are to be controlled from the downstream or blow-off end of the water line. Service connections shall be disinfected also. The location of sampling points shall be specified by the City Inspector and as specified by the Florida Department of Environmental Protection (FDEP). The sample points must have a brass, non-threaded, smooth-nosed, downward spouted hose bib mounted on a rigid stand pipe at least three feet above the finished grade. Warning tags will be attached to each sample point by the City.

3.3.6.3. The chlorine residual is to remain in all lines for a period of 24 hours. After notification of the City Inspector, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its lengths shows, upon test, a free chlorine residual not in excess of that normally carried in the system.

3.3.6.4. After flushing, water samples collected on two successive days from the treated piping system, as directed by the FDEP and the City Inspector, shall show acceptable bacteriological results. All bacteriological testing shall be performed by a State Certified Laboratory contracted by the Contractor. Proper chain of custody procedures must be followed and samples shall only be collected by certified laboratory personnel.

3.3.6.5. Repetition of Flushing and Testing: Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure and bacteriological testing shall be repeated by the Contractor until satisfactory results are obtained.

3.3.6.6. Copies of all testing results and all related correspondence from the FDEP shall be submitted to the City of Titusville.

4. SEPARATION OF WATER AND SEWER LINES

4.1. DESIGN: The proximity of sewer lines and water mains (including appurtenances) and the type of material used for each system are important design considerations for minimizing the chance of contaminants entering the water distribution system. Refer to AWWA, Prevention of Groundwater and Sewer Backflow into Distribution Systems.

4.2. PARALLEL INSTALLATIONS: Water mains shall be laid to provide a horizontal distance of at least three (3) feet between the outside of the water main and the outside of any existing or proposed storm sewer, stormwater force main, or pipeline conveying reclaimed water regulated under Part III of Chapter 62-610, F.A.C. Water mains shall be laid to provide a horizontal distance of at least three (3) feet, and preferably ten (10) feet, between the outside of the water main and the outside of any existing or proposed vacuum-type sanitary sewer. Water mains shall be laid to provide a horizontal distance of at least (6) six feet, and preferably ten (10) feet, between the outside of the water main and the outside of any existing or proposed gravity- or pressure-type sanitary sewer, wastewater force main, or pipeline conveying reclaimed water not regulated under Part III of Chapter 62-610, F.A.C. The minimum horizontal distance between water mains and gravity-type sanitary sewers shall be reduced to three (3) feet where the bottom of the water main is laid at least six (6) inches above the top of the sewer. Water mains shall be

laid to provide a horizontal distance of at least ten (10) feet between the outside of the water main and all parts of any existing or proposed on-site sewage treatment and disposal system as defined in Section 381.0065(2), F.S., and Rule 64E-6.002, F.A.C. Exceptions to the separation requirement will be on a case-by-case basis as approved by the City and the Florida Department of Environmental Protection in accordance with the Florida Administrative Code, Chapter 62-555.314, and are made only when there is no other reasonable alternative.

4.3. CROSSINGS: Water mains crossing any gravity- or vacuum-type sanitary sewer or storm sewer lines shall maintain a separation of at least six (6), and preferably twelve (12), inches above or at least twelve (12) inches below the outside of the other pipeline. However, it is preferable to lay the water main above the other pipeline. Water mains crossing any existing or proposed pressure-type sanitary sewer, wastewater or stormwater force main, or pipeline conveying reclaimed water shall be laid so the outside of the water main is at least twelve (12) inches above or below the outside of the other pipeline. However, it is preferable to lay the water main above the other pipeline. Exceptions to the separation requirement will be on a case-by-case basis as approved by the City and the Florida Department of Environmental Protection in accordance with the Florida Administrative Code, Chapter 62-555.314, and are made only when there is no other reasonable alternative. Adequate structural support shall be made for the sewers to prevent excessive deflection of joints and settling on the water mains.

4.4. At the utility crossings described above, one full length of water main pipe shall be centered above or below the other pipeline so the water main joints will be as far as possible from the other pipeline. Alternatively, at such crossings, the pipes shall be arranged so that all water main joints are at least three (3) feet from all joints in vacuum-type sanitary sewers, storm sewers, stormwater force mains, or pipelines conveying reclaimed water regulated under Part III of Chapter 62-610, F.A.C., and at least six (6) feet from all joints in gravity- or pressure-type sanitary sewers, wastewater force mains, or pipelines conveying reclaimed water not regulated under Part III of Chapter 62-610, F.A.C.

4.5. HOUSE SEWER LATERALS: The above requirements shall apply to house sewer laterals that cross above a water line, but not to those laterals that cross at least six (6) inches below a water line.

4.6. WATER SERVICE LINES: Water services and sewer lines shall be separated in accordance with the above guidelines for water mains and sewers. The minimum horizontal separation is six (6) feet or more and in no case shall they be laid in the same trench.

5. MATERIALS FOR PIPES, FITTINGS AND VALVES

5.1. PIPE AND FITTINGS – MARKING: All potable water main pipes, including fittings, shall be color coded or marked using blue as a predominant color to differentiate drinking water from reclaimed or other water. Underground plastic pipe shall be solid-wall blue pipe, shall have a co-extruded blue external skin, or shall be black pipe with blue stripes incorporated into, or applied to, the pipe wall. Pipe striped during manufacturing of the pipe shall have continuous stripes that run parallel to the axis of the pipe, that are located at no greater than 90-degree intervals around the pipe, and that will remain intact during and after installation of the pipe.

5.2. DUCTILE IRON PIPE AND FITTINGS

5.2.1. Pipe: All sizes of pipe shall be a laying length of 18'-0" to 20'-0". Ductile iron pipe shall conform to the latest revision of ANSI/AWWA C-150/A21.50. When the installation of a main will cross storm drains, open ditches, or other pipelines, or in abnormal laying conditions, an increased pressure class of pipe may be required by the City on a case-by-case basis. Water mains in an easement paralleling a common residential property line between two or more lots shall be constructed of D.I. pipe. Jack and bore carrier pipe shall be D.I. pipe. Polyethylene encasement (thickness: 8 mils; color: white or light blue) conforming to the latest revision of AWWA/ANSI C105/ A21.5, shall be required if soil test procedures indicate a corrosive soil condition in the trench area.

5.2.2. Fittings: Cast iron fittings are not acceptable. Ductile iron fittings and special castings shall conform to the type of pipe for minimum working pressure of 150 psi. Fittings shall conform to ANSI Standard A-21.10 (AWWA C-111). Short body pattern shall normally be installed. Long body fittings shall be used where the drawing specifically calls for long body fittings or at the option of the Contractor when the laying length is not controlled by short body patterns. Fittings shall have joints to match the pipe furnished and, unless otherwise noted, shall have all bell slip-on type, all bell mechanical joints, or all flanged ends. All fittings to be shipped with gaskets, glands, nuts and bolts unless specified otherwise. Nuts and bolts shall be high tensile strength 316 stainless steel for flanged fittings and shall be marked as such on the nuts and bolts.

5.2.3. Linings and coatings: All ductile iron pipe and fittings shall be thin cement lined. The lining shall comply with ANSI/AWWA C104/A21.4, latest revision. The exterior of all buried pipe shall have a standard asphaltic coating as provided by the manufacturer. All bolts, nuts, and studs shall be standard COR-TEN®.

5.2.4. Joints: Mechanical joints and restrained joints shall conform to ANSI A21.11 (AWWA C111) Standard. Lubricants which will support microbiological growth shall not be used for slip-on joints. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for joining pipes, setting meters or valves, or other appurtenances which will expose the material to the water. EPDM rubber shall be used for gasket material.

5.2.5. Flanged joints shall conform to ANSI A21.15 (AWWA C115) ANSI B16.1 Faced and drilled 125 pound. Nuts and bolts shall be made of high tensile strength 316 stainless steel having a minimum yield strength of 45,000 psi, and shall contain sufficient chromium to resist corrosion, oxidation and rust, U.S. manufacturers only. Threads shall be in accordance with ANSI B1.1, Unified Inch Screw Threads, and with B1.2, Screw Threads, Gauges and Gauging, conforming to the course thread series (UNC) Unified Coarse, with threads Class 2A external and Class 2B internal. Bolts ¾" and smaller shall be furnished with heavy hex heads conforming to ANSI B18.2.1. Bolts larger than ¾" may have either standard or heavy hex heads conforming to ANSI B18.2.1. Tee head or hex head shall be made of high tensile strength 316 stainless steel having a minimum yield strength of 45,000 psi and comply with the dimensions outlined in ANSI/AWWA C111/A.21.11.

5.2.6. Provide mechanical joint restraint on pipe and fittings at each fitting, valve, fire hydrant connection, and on pipe joints as recommended by the pipe manufacturer or as indicated on the drawings. Provide One-Lok® as manufactured by Sigma Corporation, Cream Ridge, NJ, MEGALUG® as manufactured by EBAA Iron Sales, Inc., Eastland, TX, Grip Ring® as manufactured by Romac Industries, Inc., Bothell, WA, or Ford Series 1400

mechanical restraint. The location and length of restrained pipe, fittings and appurtenances shall be clearly marked on the plans. Push-on restrained joint pipe for ductile iron pipe shall use Fast-Grip® by American Ductile Iron Pipe, Birmingham, AL, Field Lok® by U.S. Pipe, Birmingham, AL, or City approved equal gaskets.

5.2.7. Sleeve type couplings: Provide couplings where needed to make piping connections. Provide full-length mechanical joint ductile iron solid sleeve, 12" minimum length. Provide cutting-in sleeve where installing fittings in an existing line (provide ductile iron with mechanical restraint joint).

5.3. PVC (Polyvinyl Chloride) PIPE

5.3.1. Four (4) inch through twelve (12) inch PVC pipe shall conform to the requirements found in AWWA Standard C-900 (PVC Pressure Pipe), and fourteen (14) inch through forty eight (48) inch PVC pipe shall conform to the requirements found in AWWA Standard C-905. The pipe shall be Class 150 (DR 18), and shall bear the seal of a testing agency verifying the suitability of the pipe material for potable water service. The pipe shall have the following markings: Manufacturer's name; DR 18; Class 150; C-900; ASTM D-1784; NSF-PW.

5.3.2. All PVC pipe, fittings and adapters shall bear the seal of approval of the National Sanitation Foundation, Standard No. 14.

5.3.3. Bell and spigot PVC pipe shall have rubber ring gaskets which conform to manufacturer's standard dimensions and tolerances and meet the requirements of AWWA Specifications. Integral wall bell to be ASTM D-2122 (C-900).

5.3.4. Solvent cement jointing of PVC pipe is not permitted.

5.3.5. All PVC water mains shall have a suitable conductive location wire buried over the water main. The wire is to be 14 gauge single-conductor copper with blue insulation color. *Only blue color is acceptable*. The wire shall be continuous between fittings and secured to each valve and fire hydrant. Where other lines or service lines join the water main, the wire shall be secured to each line with a wire nut, taped, and sealed against moisture. All fire hydrants shall have the wire wrapped around the barrel section to grade level and be connected to the wire on the main. All valves shall have a minimum of four (4) feet of wire into each valve box, connected to the main wire.

5.4. GATE VALVES

5.4.1. All valves will meet or exceed all requirements of AWWA C-509 Standards, latest revision. All valves shall be resilient wedge gate valves. All valves shall be equipped with a non-rising stem. All iron body parts will be full wall ductile iron conforming to the requirements of ASTM A395 or ASTM A536 and contain no more than 0.08 percent phosphorus and valves will be cast with a flat bottom design to allow them to stand upright during installation or storage. Outer valve body will have raised lettering cast in, providing manufacturer's name, valve size, year of manufacture, pressure rating, location of casting, and each part is to be clearly marked with either "D.I." or "ductile iron". All valves will be electrostatically fusion-bonded, epoxy coated, minimum 8-mil thickness inside and out, conforming to ANSI/AWWA C550-01 Standards or latest revision. Resilient wedge to be ductile iron fully encapsulated with EPDM elastomer, including guide path, and will be US

Food and Drug Administration approved for potable water and have an EPDM visible marking. All valves will have 250 psig working pressure and a 500 psi static test pressure. Valve stem material will be 18-8 stainless steel, Type 304, ANSI 420/ASTM A276 with no measurable level of lead content. Valves will have two upper o-ring seals on the stem above the thrust collar and at least one o-ring seal below the collar so designed to allow for replacement of the upper o-rings with the valve under full operating pressure. Valves will have thrust washers located above and below the thrust collar to insure a smooth frictionless operation. All valves are to be opened Left (counter-clockwise). All valves will have a 2" Ductile Iron wrench nut with the direction of valve operation clearly visible when looking down on the nut. Hold down nut or bolt will be Type 316 stainless steel. All exterior bonnet and thrust collar bolting, whether recessed or exposed, is to be Type 316 Stainless Steel and marked by type. The waterway seat area will be smooth without ridges or cavities and valves will have full size bore throughout the flow-way. All valves will be hydrostatically pressure tested prior to shipment in compliance with AWWA C-509 Standards, and will be covered by the manufacturer's Ten Year Limited Warranty from date of purchase by the end user. Joint connections as specified will conform to ANSI/AWWA Standards as follows:

a. Flanged outlets will conform to dimensions and drillings of ANSI B16.1 Class 125 or ANSI/AWWA C110/A21.10 and will not be considered equal to Tapping Outlets.
b. Mechanical Joint outlets shall conform to ANSI/AWWA C111/A21.11
c. Tapping Valves shall have an alignment boss on the flanged outlet with a mechanical joint outlet conforming to ANSI B16.1, Class 125 and ANSI/AWWA C111/A21.11. (Flanged outlets are not an acceptable substitute for tapping purposes.)
d. Threaded outlets will be NPT threads conforming to ANSI B1.20.1.

5.4.2. Provide stem extensions on all valves where the top of the operator nut is located greater than thirty six (36) inches below the top of the valve box.

5.4.3. On straight run distribution mains valves shall be placed no more than 800 feet apart and at intersections as required for isolation as determined by the City. Additional valve placement within commercial and residential developments may be required by the City on a case-by-case basis.

5.4.4. All valves installed in the water distribution system and water main extensions shall be protected by an adjustable 5-1/4" cast iron valve box similar, or equal, to Industry Standard #461-S or 562-S. Covers will be marked "water" and painted with Rust-Oleum Safety Blue #925. The box must be full length with bell end over operating nut. Cut pipe sections will not be allowed as valve box extensions. When the depth of the operation nut is greater than thirty six (36) inches, a valve stem extension with a centering ring shall be installed and bolted onto the valve nut.

5.4.5. Future access line valves, located at a temporary dead end, shall conform to the City of Titusville standard blow-off detail.

5.5. FIRE HYDRANTS

5.5.1. All hydrants shall meet or exceed ANSI/AWWA C-502's latest edition for dry-barrel fire hydrants and shall in addition meet the specific requirements and exceptions which follow. Hydrants shall be assembled and tested in a certified manufacturing facility within the United

States. Hydrants shall be listed by Underwriters Laboratory and approved by Factory Mutual for fire line service. UL and FM trademarks shall be cast on the hydrant nozzle section.

5.5.2. Hydrant valve opening shall have an area equal to the area of a 5 1/4-inch minimum diameter circle and be obstructed only by the valve rod. Hydrant main valve closure shall be of the compression type opening against pressure and closing with pressure. Main valve shall be EPDM rubber.

5.5.3. All internal operating parts shall be removable without requiring excavation. Hydrants shall be hydrostatically tested as specified in AWWA C502 and shall be rated at 250 psi minimum working pressure. Hydrant bonnets, weather cover, nozzle section, caps and shoe shall be cast or ductile iron. Hydrants shall consist of one (1) 4.5" NST pumper nozzle and two (2) 2.5" NST hose nozzles. Nozzles threaded into the nozzle section shall have Never-Seez or City approved equal applied at the factory while being assembled. Cap threads shall be lubricated with Never-Seez or City approved equal before delivery.

5.5.4. Hydrant shoe shall have an electrostatic applied, fusion bonded, epoxy coating internally and externally. The coating shall meet or exceed the requirements of AWWA C-550. Coating to be applied only at the manufacturer's facility. The standpipe shall be Bitumen coated or fusion bonded epoxy coated internally and externally with a bury line present below the break flange to indicate proper installation depth. Bury depth shall be clearly marked on standpipe. All hydrants shall be clearly stenciled "Titusville" on the standpipe.

5.5.5. The hydrant's upper and lower stem, as well as its break coupling and internal pins and clips shall be manufactured of stainless steel, type 304 or 316 grade with no measurable level of lead content. Breakaway coupling may be fusion bonded epoxy coated cast/ductile iron with stainless steel pins. All external bolting shall be manufactured of stainless steel, type 316.

5.5.6. All hydrants shall be of the traffic breakaway type and allow 360-degree rotation to position the pumper nozzle in the desired direction after installation. A lubrication port shall be provided for the installation of lubrication without disassembly of the bonnet section. The reservoir shall be filled with NSF/FDA approved food grade grease at the manufacturer's facility.

5.5.7. The main valve shall not bottom out onto the shoe section. Travel stop nuts may be used in bonnet section to prevent this. Operating nut shall be a 1 ½" pentagon bronze nut and shall open counter clockwise and have a protective weather cover. Drain holes will not be permitted. If hydrant is manufactured with drain holes, then drain holes shall be plugged with brass plugs.

5.5.8. All hydrants shall be covered by a Manufacturer's Ten (10) Year Limited Warranty from the date of purchase by the end user and delivered within thirty (30) days from receipt of purchase order.

5.5.9. All hydrants will have an external sprayed on epoxy coating applied at the factory. Epoxy coating shall be Sherman-Williams Acrolon 218 HS, an Aliphatic Acrylic Polyurethane, or City approved equal. The color for all City owned and maintained hydrants shall be #95-8002 Safety Yellow (Color #330). The color for all privately owned and maintained hydrants shall be red.

5.5.10. Non-operational hydrants on untested lines will have an out of service tag on the hydrant.

5.5.11. All hydrants shall stand plumb with the pumper nozzle facing the street curb and the bury line of the hydrant at the finished grade. The break-away flange and bolts must not be in contact with the ground or the concrete hydrant protection pad. A 24" x 24" x 6" pad must be poured around the barrel bury line or no deeper than 12" below grade. Proper soil compaction shall be done before pouring pad. In unstable soil, the hydrant shoe shall be placed directly on a concrete pad, 18" x 18" x 4", prior to mechanical restraining (see Detail). Various means of mechanical blocking are acceptable, re: hydrant tees, M.J. anchor couplings, retainer glands and threaded tie-rods (see Detail).

5.5.12. All hydrants shall be a minimum of six (6) inches inside diameter and be provided with a six (6) inch valve between the hydrant and the main. The hydrant valve shall be installed within five (5) feet of the hydrant. Fire hydrants shall be located as shown on the plans in a completely accessible location, maintaining a minimum of three (3) feet and a maximum of eight (8) feet from the back of curb. In residential locations, hydrants are usually to be located at intersections or property corners. Hydrant locations on or near state highways shall be in accordance with Department of Transportation requirements. City of Titusville Water Resources Department and Fire Department personnel, Brevard County Fire Department, and Department of Transportation have the final authority to mandate fire hydrant placements and/or relocations.

5.6. WATER SERVICES

5.6.1. All installations shall be installed in accordance with City of Titusville Specification details for single, double, or multiple service lines. All water service lines one (1) inch in diameter shall be constructed of Type "K" soft copper, which shall conform to the requirements of AWWA Standard C-800. Two (2) inch diameter service lines shall be constructed of Type "K" copper tubing or SODR 9 EndoTrace blue polyethylene as manufactured by Endot Industries, Inc., Rockaway, NJ (using compression adapters). All multiple service line group installations numbering more than four will be required to utilize a two (2) inch service line manifold installation (see Detail).

5.6.2. Location: All service lines will be located in the right-of-way. Service lines shall not be terminated in the sidewalk or within two (2) feet adjacent to driveways. Location of service lines in single family and townhouse developments shall be at alternating lot lines. Multiple service line installations shall be located in common areas, and curb stops spaced no more than 18-20 inches apart in single file. Curb stops shall be mounted in a horizontal position at a depth of no greater than ten (10) inches from finished grade.

5.6.3. Meter boxes must be installed at the time of service line installation, prior to final inspection. Refer to Paragraph 5.7.7.

5.6.4. Service saddles: Service saddles shall be used for all connections to PVC pipe. Saddle body for C-900 pipe shall be nylon/epoxy coated ductile iron and tapped for AWWA/CC threads. Body and bands must be factory pre-sized for C-900 pipe diameter. Bands shall be stainless steel, minimum two (2) inches wide. Reference: Smith Blair 315 and 317, or City approved equal (brass saddles are acceptable).

5.7. TAPPING

5.7.1. Service saddle placement on main shall be at least 45 degrees off vertical and not to exceed horizontal positioning. No vertical tapping will be allowed except at temporary jumper connections.

5.7.2. Tapping PVC Pipe: Only shell cutters will be used to tap PVC pipe. The removal of the tapping coupon is required. The use of a wood bit and brace and hole saws is prohibited.

5.7.3. The tapping saddle and corporation stop must be installed by the Contractor and inspected by the City Inspector prior to the City making the tap. Only wet tapping will be permitted on water mains that are currently in-service.

5.7.4. Corporation stops shall be cc thread to CTS. Corporation stops will be used only for one (1) inch taps. Mueller No. H-15008, or City approved equal.

5.7.5. Curb stops shall be CTS to FIP for one (1) inch. No H pattern or roundway type will be permitted. Curb stops will be used only for one (1) inch service lines. Acceptable: Mueller H-15166, H-15174, B-25170, or City approved equal.

5.7.6. All service lines greater than one (1) inch in diameter shall meet the requirements of the specifications for one and one half (1-1/2) inch and two (2) inch meters (refer to Standard Details for Meter Installations).

5.7.7. Meter protection boxes shall be according to size of service line. Meter boxes are to be DFW by NDS1200-DICIR injection molded of structural foam recycled polyolefin material with cast iron reader cover. When new service lines are installed, meter boxes shall be placed over curb stops with sufficient space for the installation of the water meter by the City. The top of the meter box shall be adjusted to grade and shall be in undamaged condition. Water meters will not be installed by the City unless all requirements of service line and meter box installations are acceptable. If it is necessary to locate meter boxes near concrete or paved areas, steel meter box covers with reader lids shall be required.

5.7.8. Large meter installations: All meters three (3) inches and larger shall be constructed with Class 125 flange fittings and shall be installed above ground. All flange fittings and valves will be restrained and tested prior to the large meter installation. The meter will be supplied by the City and may be installed by the licensed plumber or utility contractor. All meter valves are to be non-rising stem, hand wheel operation. Meters up to four (4) inches are to have a two (2) inch bypass line; meters six (6) inches and larger are to have a three (3) inch bypass line.

5.8. TAPPING SLEEVES – These specifications are according to application, size and engineering requirements.

5.8.1. Field disinfection procedures shall be utilized for the installation of tapping sleeves and tapping valves to the existing water mains. The tap sleeve and valve shall be disinfected immediately prior to the installation of the appliances to the potable water main. The application of a concentrated solution of hypochlorite (minimum, 1% available chlorine) shall be applied to the inside of the sleeve and valve. Methods of application of disinfection solution shall be by swabbing or by pressure spraying.

5.8.2. Acceptable tapping sleeves shall be all stainless steel and be S.S. 304/18-8 for sleeve, body (shell), branch, bolts and nuts. All fitting parts are heli-arc welded. Full 360 pipe coverage gasket sealing. Flange is to be recessed per MSS SP-60. The stainless steel tapping sleeve may be used for four (4) inch through twelve (12) inch taps on four (4) inch through twelve (12) inch mains. The S.S. sleeve shall be Smith Blair 663, or approved equal, to the smallest diameter of pipe size being tapped. Notification to the City Inspector is required before installation for material inspection, and after application, of the tapping sleeve and valve for pressure test verification prior to drilling.

5.9. TAPPING VALVES

5.9.1. Tapping valves shall be field disinfected as required in Section 5.8.1.

5.9.2. Tapping valves shall be resilient seated, non-rising stem, open left, two (2) inch square operating nut, for vertical mounting in approximately level setting on buried water lines. The valves shall conform to AWWA Standard C-500 or C-509, latest edition. All resilient seat tapping valves shall be full port size waterway.

5.9.3. The valve inlet shall be flange Class 125, with ring guide as per MSS SP-60. Outlet shall be mechanical joint as per AWWA C-110.

5.9.4. Proper trench support of the tap valve is required during the drilling operation.

5.10. FIRE LINES: Fire lines for commercial, industrial, residential or other buildings may be required by the City of Titusville Fire Marshall. All new fire line systems connected to the City of Titusville water distribution system shall have an approved backflow prevention device installed at the water source. This device shall be a Double Check Detector Assembly with OSY resilient gate valves with a bypass monitor meter. As per Fire Department requirements, the device shall be installed above ground. Location of the device inside structures shall be reviewed for acceptance by the CoTWRD (see Standard Detail). The installation of the DCDA device will be inspected by the City Inspector and test results shall be submitted to the CoTWRD. All device locations shall be reviewed for approval by the CoTWRD. Inspection and testing of the fire line by the Fire Inspector shall begin at the outlet valve connection. All installations inside structures shall have a remote read register located in an accessible area.

5.11. BACKFLOW PREVENTERS: The City of Titusville has the primary responsibility of protecting the potable water distribution system against possible contamination or pollution resulting from a source of cross connection or backflow conditions. In consonance with the above, the City shall require backflow preventers as needed.

5.11.1. All construction and all major modification will be reviewed for the requirement of a backflow preventer. The determination of the type of backflow preventer required will be based upon the "degree of hazard" of on-site facilities or equipment. When a required backflow preventer device is not installed, or is removed or by-passed, non-compliance with these requirements by law may result in the termination of water services to the premises. Two main types of backflow preventers are acceptable:

a. the Double Check Valve Assembly, and
b. the Reduced Pressure Principle Backflow Preventer.

5.11.2. These devices shall meet the requirements of AWWA Standard C-506, "Recommended Practice for Backflow Prevention and Cross Connection Control", and be approved by the Foundation for Cross Connection Control and Hydraulic Research.

5.11.3. Following is a partial list of facilities requiring backflow preventer installation at the water meter: manufacturing, processing, and fabricating plants; supermarkets and food processing businesses (restaurants); schools, laundries, piers, medical, health or beauty businesses; booster pump and other pressure systems (water and sewer); boilers, water-cooled A/C systems, irrigation systems, multi-story buildings over two stories, etc. For a complete list of facilities requiring backflow prevention, contact the City's Field Operations Division.

5.11.4. These requirements are in compliance with laws and regulations of the E.P.A. Safe Drinking Water Act of 1974; the Florida Statutes, Rules of the Department of Environmental Protection (DEP) Section 62-555-360; Florida 1977 "Cross Connection Control and Backflow Prevention, Southern Standard Plumbing Code, Appendix D, Section D-2(a)-(d); and the "City of Titusville Water Resources Department Cross-Connection Control Program Manual". All devices 3/4" through 2" shall have threaded ends. As of July 1986, all BFP devices are to have ball valve or resilient seated inlet and outlet valves. All devices must be testable in-line. Two backflow prevention assemblies in a parallel mounting system may be installed for facilities that require full-time, uninterrupted water service during device testing or maintenance. It is the City's responsibility to install (or have installed), operate and maintain the approved backflow prevention device, as directed by the CoTWRD. The devices shall be installed only by a licensed Underground Utility Contractor, Master Plumber, Certified Backflow Prevention Device Technician, or the City's Field Operations Division in the case of retro-fitting existing customers only. Refer to Standard Details.

6. PIPE INSTALLATION

6.1. TRENCH EXCAVATION

6.1.1. Make all excavations by open cut with banks of trenches at no greater than the maximum allowable slope as defined in OSHA 1926, Subpart P. Sheeting and shoring, if required for depth of trench, will conform to OSHA safety standards. A trenching box or shield may be used in place of sheeting and shoring. Make trenches wide enough to allow approximately eight (8) inches clearance on each side of the water main; bottom uniform to provide accurate and uniform bearing for as nearly the full length of pipe section as practical. Excavate bell holes after trench has been graded. Perform all excavations of whatever substance encountered to the depths shown or indicated on plans. In the event unsuitable or unstable soil is encountered, such as refuse or organic matter, it shall be removed and replaced with approved material in six-inch compacted layers at a depth of twelve (12) inches below main. All excavated material shall be piled in a proper manner that will not obstruct sidewalks, roads or driveways. Fire hydrants, valve boxes and other utility controls shall be left unobstructed and accessible until work is completed. Street drainage shall not be obstructed.

6.1.2. The Contractor shall furnish all equipment and labor necessary to remove storm or subsurface waters from excavation areas to maintain the excavations free of water while construction is in progress. The dewatering of any excavation areas and the disposal of the water shall be in strict accordance with the latest revision of all local and state

government rules, regulations and permits. The Contractor is responsible for obtaining any dewatering permits required from St. Johns River Water Management District. The Contractor shall utilize suitable equipment to adequately dewater the excavation so that it will be dry for work and pipe laying. A wellpoint system, or other dewatering method approved by the respective jurisdictional agency(ies), shall be utilized if necessary to maintain the excavation in a dry condition for preparation of the trench bottom and for pipe laying. Discharge to storm sewers, canals, streams, or wetlands only if specifically allowed for in the Dewatering Permit. In no case shall discharge result in turbidity reaching wetlands or any waterways. Construct temporary culverts, barricades and other protective measures to prevent damage to property or injury to any person or persons. Flooding of streets, roadways, driveways or private property will not be permitted. Engines driving dewatering pumps shall be equipped with residential type mufflers.

6.2. HANDLING AND CUTTING PIPE: Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring machined surfaces, and abrasion of the pipe coating. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused a fracture (even though no such fracture can be seen), shall be marked as rejected and removed at once from the work site. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved, may be cut off before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be made in the sound barrel at a point at least twelve (12) inches from the visible limits of the crack. All cut ends shall be examined for possible cracks caused by cutting. All repaired or replaced sections shall be joined by M.J. gasketed fittings only.

6.3. PIPE LAYING

6.3.1. Water mains shall be constructed of the materials specified and as shown on the drawings. Each section of the pipe shall rest upon the pipe bed for the full length of the barrel, with recesses excavated to accommodate bells and joints. Any pipe which has its grade or joint disturbed after laying shall be taken up and re-laid. No pipe shall be laid when the trench conditions or the weather is unsuitable for such work, except by permission of the City. Any section of pipe already laid which is found to be defective or damaged shall be replaced with new pipe without additional cost to the City. Excavation, trenching and backfilling shall be in accordance with the requirements of the applicable portions of these specifications. All iron pipe and fittings shall be laid in accordance with AWWA Standard C-600, titled "Installation of Water Mains and Appurtenances". All PVC pipe shall have a continuous run of blue insulated copper wire #14 UF directly on top of the main and connected to wires on all hydrants and valves.

6.3.2. A temporary jumper connection, with an approved backflow preventer assembly, is required at all connections between existing active water mains and proposed new water main improvements. All filling and flushing of new mains is to be completed through the jumper connection. The jumper connection shall be maintained until after filling, flushing, testing and disinfection of the new main has been successfully completed and clearance for use from the Florida Department of Environmental Protection (FDEP) has peen received. The jumper connection shall also be used to maintain a minimum pressure of 20 psi in new mains at all times after disinfection and until the FDEP clearance letter is received. (See Standard Detail for temporary jumper connection.)

6.3.3. The minimum cover over all piping shall be thirty (30) inches except where specifically shown as otherwise approved. The maximum depth of cover shall not exceed forty eight (48) inches except where specifically shown as otherwise approved.

6.3.4. A conscientious effort shall be made to keep the inside of the pipeline being installed as clean as possible. Before pipe is laid, all dirt shall be removed from the inside of the pipe and all lumps, blisters, excess coal tar, dirt, oil, grease and moisture shall be removed. All foreign materials shall be removed from the inside of the bell and from the outside spigot end.

6.3.5. During times when pipe laying is not in progress, all open pipe ends or fittings shall be closed by a water tight cap or plug, or other approved method. This requirement will pertain to any time during the working day that trench pipe laying is not in progress, including overnight or weekends. When water is present in the trench, the pipe seal shall remain in place until the trench is pumped completely dry.

6.3.6. After pipe is laid, care shall be taken to avoid the entrance of dirt or water into the trench by the use of tight bulkheads.

6.3.7. To provide the capability for routing the pipe to suit unusual laying conditions, around obstacles, and moderate changes in grade, all gasketed slip joint pipe connections shall have a joint deflection of no more than 75% of the manufacturer's recommendations.

6.4. JOINT RESTRAINT: Suitable mechanical joint restraint shall be applied on all pressure pipe lines (except for those having screwed or flange joints) at all tees, plugs, caps and at bends deflecting 11-1/4 degrees or more. All joints within twenty (20) feet of fittings shall be restrained. Mechanical joint restraint shall be MEGALUG®, One-Lok®, or Romac Grip Ring®. All mechanical joint restraints will be left uncovered for inspection before backfilling.

6.5. STREET CROSSINGS

6.5.1. Water mains crossing paved roadways where open trenching is not permitted shall be placed in a jack and bore steel casing, as per D.O.T. Specifications. The carrier shall be ductile iron, supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes shall be distributed along the casing by use of approved casing spacers. Casing spacers shall be made of a high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction.

6.5.2. City, County, or State road crossing permits are required prior to starting street crossing construction. It is the Contractor's responsibility to obtain the necessary permits for road crossings for jack and bore construction or open cutting.

6.5.3. Water service lines crossing paved roadways shall be installed by push/pull (reaming) method. The Contractor shall furnish all material, equipment, transportation, tools and labor, and shall comply with all regulations of the governing authority to install the service lines.

6.5.4. The Contractor shall be responsible for locating and verifying existing underground utilities and services and structures in advance of construction. The Contractor shall conduct exploratory excavations in areas of potential conflict or connection. The push/pull operation shall be done sequentially and continuously for one

machine setup. Correct line and grade shall be carefully maintained. Add-on sections shall be sealed together to provide watertight total pipe strength joints. The installation shall produce no upheaval, settlement, cracking, movement or distortion of the existing or proposed road bed or other facility. The maximum pull back (reamer) shall not be greater than two (2) inches greater than the pipe outside diameter to be installed. The pipe to be pulled back shall not exceed the approved boring diameter of the machine (see approved machine list below). The following machines are approved for the installation of water service lines crossing paved roads: FlowMole Vector, Melfred Borzall Systems, Straightline DL405, Ditch Witch 4/40 and 4/40A Jet Trac, American Directional Drills DD-15, Vermeer Navigator, and Dixie Power Mole. A minimum of three (3) feet of cover is required for all water service lines under roads. Required push/pull pits or shafts shall be excavated and maintained to a minimum dimension. The excavation shall be adequately barricaded, sheeted, braced, and dewatered as required, in accordance with applicable sections of these specifications.

6.6. BACKFILL

6.6.1. Excavated material that is suitable, as determined by the City Inspector, may be used for backfilling. The Contractor shall procure additional material, where necessary, at no additional cost to the City.

6.6.2. The material used for backfill shall be fine, loose earth, free from clods, stones, refuse and organic material; subject to the approval of the City Inspector.

6.6.3. Place all backfill in layers compatible with compaction requirements unless otherwise specified.

6.6.4. Backfilling: After pipe and conduit have been inspected and approved, backfill the trenches, carefully depositing the fill and compacting to the center line of the pipeline on both sides. Place the remainder of the backfill in maximum one-foot layers and compact in conformance to AWWA C-600, Section 3.5. After backfilling, dress trenches to conform to adjacent contours. If trenches are improperly filled or if settlement occurs, they shall be refilled and re-dressed. All valves, fittings and restrained joints shall be left uncovered for inspection and acceptance by the City Inspector. The City Inspector has the authority to require excavation of any appurtenances for verification of construction techniques.

6.7. COMPACTION REQUIREMENTS: Place backfill in equal layers, compatible with equipment used, and compact each layer in accordance with Table II below and ASSHTO T-180. Fill and backfill not included in Table II shall be compacted to 90% of maximum density at optimum moisture.

TABLE II

LOCATION OF BACKFILL	PERCENT OF MAXIMUM DENSITY AT OPTIMUM MOISTURE
Under slabs	98
Under structures	98
Under paved areas:	
upper 12 inches	98
below 12 inches	95

7. FINAL ACCEPTANCE BY THE CITY

7.1. Final acceptance of the water distribution system and/or water main extension(s) will be made only after:

A. All tests have been completed, passed, and approved by the City Inspector,

B. A final walk-through has been completed and the improvements are found to be in accordance with the applicable regulations of the City, the Florida Department of Environmental Protection, and the standards contained herein, and

C. The City is furnished with all of the following applicable items:
   1. Three (3) certified paper copies of as-built drawings by a Florida Registered Surveyor or Engineer, with elevations based on the North American Vertical Datum of 1988 (NAVD 88), and an electronic copy in AutoCAD format, in state plane coordinates, in accordance with the “City of Titusville Minimum Requirements for As-Built Drawings” checklist.
   2. Certification of Substantial Completion noting any deviations from the Engineer of Record.

CITY OF TITUSVILLE

WATER RESOURCES DEPARTMENT

Safety Requirements for Contractors and Subcontractors

Table of Contents

Purpose 3
Application 3
Scope 3
General Requirements 3
Control of Fugitive Emissions 4
Accidental Spills and Releases 4
Other Potential Safety Hazards 5

Specific Program Requirements

Asbestos and Suspect Asbestos Containing Materials 5
Lead-containing Materials 5
Confined Spaces 6
Hazard Communication 7
Electrical Safety and Lockout/Tagout 8
Trenching and Excavations 8
Fall Protection 9
Hoists & Cranes 9
Hot Work 10
Work Area Traffic Control 10
Personal Protective Equipment 10
Work Site Inspections 10

Definitions 11

Appendix A 12

Purpose
The *Safety Requirements for Contractors and Subcontractors* is intended to assure the safety of City of Titusville employees and the public who may be in proximity to renovation, demolition, installation, or maintenance operations conducted by Contractors or Subcontractors. Every Contractor is expected to take steps as necessary to protect the safety and health of City employees, visitors and the public during the performance of their work. Each Contractor that coordinates the work of Subcontractors shall assure that they abide by the requirements outlined herein.

Application
Each department that coordinates or uses the services of a Contractor to perform maintenance, repair, installation, renovation or construction-related operations is expected to designate one or more persons to coordinate this program within his or her department. These Project Managers or Project Coordinators will assure that the Contractor is:

- Informed of the presence of hazards in or near the work area.
- Informed about requirements related to asbestos, lead, confined space entry, lockout/tagout, hot work, maintenance of traffic and excavation operations.
- Aware of the City's expectations regarding safety compliance and the control of worksite hazards.

Scope
This program applies to all City of Titusville projects, and to all work performed by Contractors or Subcontractors on City of Titusville properties

General Requirements
A copy of this document shall be made available upon request to prospective bidders/offerors at the pre-bid/pre-proposal conferences for the work. This document shall be either included with, or referenced in, the contract documents.
Submittals, where required from the Contractor by this document, shall be made in writing directly to the Purchasing and Contracting Division and copied to the Project Manager/Coordinator. Submittals shall be made sufficiently in advance to avoid delay of the project.

Where review, approval, or coordination of submittals is required, submittals shall be made at least ten (10) working days prior to the start of the project unless prior arrangements have been made. Post-job submittals, where required as outlined in this document, shall be made no later than fifteen (15) working days after completion of the project or as specified herein.

The Contractor shall provide the Project Manager/Coordinator with emergency contact phone number(s), usable 24 hours a day, for the Contractor's representative.

The Contractor bears sole responsibility for the safety of his or her employees. The Contractor is expected to take all steps necessary to establish, administer, and enforce safety rules that will meet the current requirements of the Occupational Safety and Health Administration (OSHA) and any other state or local standards, regulations or codes. These regulations include, but are not limited to:

- Title 29 of the Code of Federal Regulations (CFR) Parts 1910, Occupational Safety and Health Administration (OSHA) Standards for General Industry,
- Title 29 of the Code of Federal Regulations (CFR) Parts 1926, Occupational Safety and Health Administration (OSHA) Standards for the Construction Industry.

The Contractor bears sole responsibility for communication of safety-related information and requirements to his or her Subcontractors. The Contractor shall assure that his or her Subcontractors comply with the requirements outlined herein.

Control of Fugitive Emissions

The Contractor shall take all necessary precautions to control or contain fugitive emissions from the job site. Fugitive emissions include, but are not limited to:

- Nuisance dust,
- Chemical odors/vapors,
- Hazardous materials (such as lead dust or asbestos), and
- Noise.

Where the product(s) or material(s) to be used by the Contractor has a permissible exposure limit (PEL) established by OSHA, the contractor shall submit a written plan to the Project Manager/Coordinator prior to the work. This plan shall detail the methods that will be employed by the Contractor to limit, control or eliminate exposure of City employees or the public to these hazards. Where engineering controls will not control fugitive emissions of these chemicals or materials or are not feasible, the contractor shall monitor, or shall contract to have monitored, work area exposure conditions. Monitoring shall occur, at a minimum, during the start of work and whenever there is a change in procedure, process, or chemical or material used. A copy of the monitoring results shall be submitted to the Project Manager/Coordinator within 24-hours of receipt by the Contractor.

Accidental Spills and Releases

In the event of an accidental release or spill of chemicals or other hazardous materials the Contractor shall:

- Immediately take action as appropriate to contain the spill if this action can be taken without jeopardizing the health or safety of employees,
- Notify the fire department, or other entities as needed or required,
- Contact Human Resources Risk Manager at 321-383-5822, and
- Contact the Project Manager/Coordinator.

All costs associated with responding to or remediation of a chemical or hazardous material spill or release is the responsibility of the Contractor.

Other Potential Safety Hazards
The Contractor shall abide by the requirements of any sign posted in a building that requires the use of specific personal protective equipment, that restricts access to qualified or authorized persons only, or that establishes requirements for entry.

Specific Program Requirements

Asbestos and Suspect Asbestos Containing Materials
It will be the responsibility of the Contractor to provide his or her own asbestos awareness program which shall include, but is not limited to, the information contained in this section and the OSHA asbestos-related regulations (29 CFR 1926.1101). Verification that this training has been conducted shall be supplied to the City upon request.

Contractors employed by the City to perform building or facilities-related maintenance, repair or renovation shall be informed by the Project Manager/ Coordinator of the location of suspect and known asbestos-containing materials (ACM) in the work area(s) to which they are assigned by one of the following means:

- The Project Manager/Coordinator shall provide the Contractor with a copy of a an asbestos inspection report specific to their work and the materials that are to be disturbed, or
- Where the construction documents for a project clearly detail asbestos locations within the work area, these documents may serve in lieu of the inspection report.

An asbestos inspection report may, at the discretion of the Purchasing and Contracting Division, be prepared by an asbestos consultant licensed in Florida to perform the duties of Asbestos Inspector and Asbestos Management Planner.
Contractors shall, under no circumstances, damage or disturb suspect or known ACM unless they are a licensed Asbestos Abatement Contractor and have been specifically employed to perform asbestos repair or removal. If suspect asbestos materials are discovered during the course of the work, the Contractor shall stop work immediately and notify the Project Manager/Coordinator.
The Contractor shall not proceed with any change in work that requires a material to be disturbed that the asbestos inspection report, or construction documents show has not previously been tested (e.g. "suspect" ACM). If a change in the scope of work becomes necessary, the revised scope of work shall be reviewed and pre-approved by an authorized person.
Asbestos materials may not be used or installed in any City facilities.

Lead-containing Materials
Contractors employed by the City to perform building or facilities-related maintenance, repair or renovation shall be informed by the Project Manager/Coordinator of the location of lead-containing building materials in the work area(s) to which they are assigned by one of the following means:

- The Project Manager/Coordinator shall provide the Contractor with a copy of a lead inspection report specific to their work and the materials that are to be disturbed, or

- Where the construction documents for a project clearly detail the location of lead-containing materials within the work area, these documents may serve in lieu of the inspection report.

A lead inspection report may, at the discretion of the Purchasing and Contracting Division, be prepared by a lead consultant licensed in Florida to perform the duties of Lead Inspector.

Contractors that will disturb lead-containing building materials during the course of the work shall take all necessary precautions to protect City employees, and the public from exposure to lead dust or contamination. These measures shall conform, at a minimum, to the OSHA requirements detailed in 29 CFR 1926.62 and applicable local, state and federal regulations. The Contractor shall submit a copy of his or her lead compliance program, as required by 29 CFR 1926.62(e), with required supporting documentation for prior review and approval. This submittal shall be made sufficiently in advance of construction to avoid delay of the project.
A copy of the analytical report(s) for any personal air samples taken during the course of the work shall be provided to the City.
The Contractor shall not proceed with any change in work that requires a material be disturbed that the lead inspection report, or construction documents shows has not previously been tested unless pre-approved work procedures will be followed.
Where lead-containing materials will be disturbed or removed during the course of work, the Project Manager/Coordinator shall determine disposal requirements. If the lead-containing materials will constitute a hazardous waste, disposal of these materials shall be in accordance with applicable local, state and federal requirements. The disposal requirements must be established during the design of the project.

Confined Spaces
When the Contractor must perform work that involves entry into a permit-required confined space, the Project Manager/Coordinator shall:
- Inform the Contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements set forth by OSHA (1910.146).

- Apprise the Contractor of the elements, including the hazard(s) identified and the City's experience with the space that make it a permit-required confined space.

- Apprise the Contractor of any precautions or procedures that the City has implemented for the protection of City employees in or near permit spaces where contractor personnel will be working.

- Coordinate entry operations with the Contractor when both City personnel and contractor personnel will be working in or near permit spaces.

- Debrief the Contractor at the conclusion of the entry operations regarding the permit space program followed and any hazards confronted or created in permit spaces during entry operations.

- Provide a copy of the City of Titusville's Confined Space Entry Program to the Contractor upon request.

Information on City's Confined Space Entry Program and information on specific confined spaces on City of Titusville properties may be obtained by contacting the Water Resources Safety Coordinator at 321-383-5656

Each Contractor who is retained to perform work that will require permit space entry operations shall:

- Coordinate entry operations with the Project Manager/Coordinator when both the Contractor and City personnel will be working in or near permit spaces,
- Inform the Project Manager/Coordinator in writing of the permit space program the Contractor will follow, including written certifications for Entry Supervisors, Attendants or Entrants.
- Inform the Project Manager/Coordinator of any hazards confronted or created in permit spaces during entry operations.
- Provide a copy of the Contractor's Confined Space Program to the City upon request.
- Inform the Project Manager/Coordinator in writing of the rescue services/team they will be using during permit entry.
- Provide a copy of the canceled permit(s) to the Project Manager/Coordinator and Water Resources Safety Coordinator at the conclusion of entry operations.

Hazard Communication

Chemicals are used at City of Titusville facilities. Chemical use is routine in, but is not limited to, the following areas or locations:

- Laboratories.
- Fume hood exhausts on the roofs of laboratory buildings. (In general, signs have been posted on the roof access hatch or door restricting access to the roofs of buildings where fume hood exhausts are located).
- Chemical stock rooms.
- Chemical waste accumulation areas.
- Water Production and Reclamation Facilities
- Paint and chemical storage areas.
- Maintenance Facilities.

The Project Manager/Coordinator shall inform the Contractor of the following:

- Known hazards and any required safety procedures that must be followed in the Contractor's work area.
- Method for obtaining access to Material Safety Data Sheets (MSDS) for hazardous chemicals present in the Contractor's work area.
- Information about the labeling system used in the work area.
- Emergency procedures that the Contractor is to follow in the event of accidental exposures or releases of hazardous chemicals.

MSDS are required to be maintained and to be accessible to employees in each work area, and MSDS for all chemicals may be obtained from the Human Resources Risk Manager.

The Contractor shall maintain, on-site, MSDS for all hazardous chemicals used or stored at that job site. Copies of MSDS shall be provided to the Project Manager/Coordinator by the Contractor prior to start of work.

The Contractor shall take precautions to ensure hazardous chemicals or materials are handled and disposed of in accordance with federal and state regulations. Where a hazardous waste disposal manifest is required by these regulations, the Contractor shall consult the Project Manager/Coordinator to assure that manifesting, storage, and the proposed disposal method and disposal site meet requirements. The Contractor shall supply a copy of the completed waste manifest to the Project Manager/Coordinator within 24-hours of receipt.

Where the Contractor has secured air samples documenting employee exposure to airborne chemical or particulate hazards during the course of their work, a copy of all air samples results shall be provided to the Project Manager/Coordinator within 24-hours of receipt by the Contractor.

Electrical Safety and Lockout/Tagout

The Project Manager/Coordinator shall inform the Contractor of City of Titusville lockout/ tagout procedures.

The Contractor shall ensure that his/her personnel understand the City's energy control procedures and comply with the requirements of the City's lockout/tagout program.

A copy of the City's Electrical Safety and Energy Control Policy programs shall be provided to the Contractor upon request. If the Contractor will be using their own lockout/tagout procedure, the Project Manager/Coordinator shall ensure that City personnel in the work area understand the Contractor's control procedures and that they comply with the requirements of the Contractor's program. A copy of the Contractor's electrical safety and lockout/tagout programs shall be made and provided to the City before commencement of work.

Trenching and Excavations

The Contractor shall coordinate trenching and excavation work with the Project Manager/Coordinator, and 1-800-SUNSHINE to assure the coordination of work and shutdown of utilities if necessary.

The design of sloping and benching systems, support systems, shield systems or other protective systems shall conform, at a minimum, to the OSHA requirements detailed in 29 CFR 1926 Subpart P.

Trenching or excavations below the level of the base or footing of any foundation or retaining wall, or adjacent to any utility, sidewalk or roadway, will not be permitted unless:

- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure, or
- The excavation is in stable rock, or
- A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity, or
- A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees or the structure.

This determination is the responsibility of the Contractor except as permitted, required or otherwise allowed by the project specifications or drawings.
The Contractor shall notify the Project Manager/Coordinator of the name of the individual that is to serve as the Contractor's competent person as defined by this program and the OSHA regulations. The Contractor's designated competent person shall maintain a written log of the daily inspections made of excavations, adjacent areas, and protective systems. A copy of this written log shall be made available to the City upon request. Where the design of a sloping and benching system, support system, shield systems or other protective systems requires review and approval by a registered professional engineer, the Contractor shall submit a copy of the completed review to the Project Manager/Coordinator prior to start of work.

Fall Protection
Fall protection may be needed in work involving ramps, runways, and other walkways; excavations; hoists; holes; form work and reinforcing steel; leading edges; unprotected sides and edges; overhand bricklaying and related activities; roofing; pre-cast concrete erection; wall openings; scaffolds; ladders; and other walking/working surfaces, in accordance with 29 CFR 1926 Subpart M. Protect employees working 6 feet (1.8 meters) or more above a lower level and those who may fall into dangerous equipment. Typical fall protection systems include controlled access zones, guardrails, fences, covers, safety nets, and personal fall arrests.

For work conducted for the City of Titusville in which fall hazards are present, use employees trained on how to recognize and minimize fall hazards and how to properly use fall protection systems and equipment. **MAKE DOCUMENTATION OF TRAINING AVAILABLE** to the City upon request.

Hoists and Cranes
Designate a competent person who will inspect all machinery and equipment prior to each use, and during use, to make sure it is in safe operating condition. Repair deficiencies and replace defective parts before continued use. Install barricades to prevent injury to employees or passers-by (Reference 29 CFR 1926, Subpart N).

Do not exceed safe working loads. Take precautions to prevent physical contact with power lines either by maintaining adequate distance, use of insulating barriers, or de-energizing of power lines, as appropriate.

Properly anchor equipment and do not use roofs or walls for a supporting brace.

Hot Work
Contractors performing hot work shall maintain a Hot Work Permit Program complying with the OSHA requirements found in 29 CFR 1926.352, ANSI Z49.1-88 and NFPA 51B. Examples of hot work include, but are not limited to, use of open flames, compressed gases or supplied fuel burning, brazing, cutting, grinding, soldering, thawing pipe, torch applied roofing, and welding. A copy of the canceled permit(s) shall be provided to the Project Manager/Coordinator after completion of the work.

Work Area Traffic Control
An approved traffic control plan is required in accordance with the Florida Department of Transportation and the Manual of Uniform Traffic Control Devices, Part VI.

Personal Protective Equipment
Personal protective equipment such as hard hats, eye protection, foot protection, hearing protection, respirators, etc., shall be worn as required, in accordance with OSHA regulations.

Work Site Inspections
Unannounced work site inspections may be conducted by City Safety Representatives or designated departmental personnel. These inspections are conducted solely for the benefit of the City, and shall not relieve the contractor of responsibility for enforcement of, and compliance with OSHA and other state and local regulations.

In the event that work site conditions exist that potentially impact the safety of City employees or the public, the inspector shall issue a verbal or written warning to the Contractor and shall notify the Project Manager/Coordinator. If the unsafe conditions can not be immediately corrected and represent a danger or have the potential to harm employees, or the public, then the inspector will:

- Detail the OSHA violations that were noted, and explain the potential impact upon employees, or the public,
- Require that the Project Manager/Coordinator have the Contractor stop work until the unsafe conditions can be mitigated,
- Issue a formal written report of the violations to the Contractor. This report shall be copied to the Project Manager/Coordinator.

Reports of deficiencies may be factored into the evaluation of the contract by the City, and may be included in a vendor complaint file that is available for review by other state agencies.

Repeat safety violations and/or a single serious, willful safety violation by a Contractor may warrant review and termination of the contract.

“Serious, willful safety violation” is defined, for the purposes of this program, as a work activity with a substantial probability that death or serious physical harm could result, and where the potential hazard was known or should have been known, but where the work activity was continued, regardless of the existence of the potential safety hazard.

Definitions

Competent Person: As related to excavation, trenching or shoring work, the Contractor's "competent person" means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Confined Space: A confined space is a space that is large enough for a person to enter, that has limited means for entry or exit, and that is not designed for continuous occupancy. Examples include tanks, silos, storage bins or hoppers, utility vaults, and pits.

Purchasing and Contracting Division: The Division of the Finance Department at the City that has contracted for work to be performed by a Contractor.

Contractor: An entity or agency employed by the City to perform the installation or maintenance of equipment, or the renovation or construction of a building, room or facility on City property.

Lockout/Tagout: A program used to ensure that employees are protected from sources of potentially hazardous energy. The program requires that hazardous energy sources be identified and locked and/or tagged-out before work is done on the system(s).

Maintenance of Traffic: Maintenance of Traffic is a reference to the Florida Department of Transportation requirement for an approved traffic control plan and FDOT certification of contractor personnel responsible for supervision, placement, maintenance or inspection of work zone traffic control, in accordance with the FDOT Roadway and Traffic Design Standards, Index 600 and Part VI of the Manual of Uniform Traffic Control Devices.

Permit-required confined space: A permit-required confined space is a confined space that contains potential or known safety hazards that must be dealt with prior to or during entry to assure the safety of those employees performing the work.

Project Manager/Coordinator: The individual(s) within a Department that has been assigned duties related to oversight or coordination of work performed by a Contractor as defined in this program.

Appendix A

The following checklist is provided to assist the Project Manager/Coordinator with complying with the requirements outlined in this program.

Name of Project Manager/Coordinator:	
Work Site(s) and Location(s):	
Applicable Date(s):	
Contractor Name:	
Contractors Representative:	
24-hour phone number:	

Action Required	☑
Traffic Control Plan Required? If yes, is the Contractor certified by the FDOT for Maintenance of Traffic?	Yes ☐ No ☐
Asbestos review required? If yes, provide inspection report to Contractor or assure that the Construction Documents detail the location(s) of asbestos within the work area.	Yes ☐ No ☐
Lead materials review required? If yes, provide inspection report to Contractor or assure that the Construction Documents detail the location of lead-containing materials within the work area.	Yes ☐ No ☐
Will the work require entry into a permit-required confined space? • If yes, inform the Contractor about known hazards and history of entry operations for each space that they will enter. Contact Water Resources Safety Coordinator at 383-5656 for assistance as needed. • If yes, the Project Manager/Coordinator will debrief the Contractor after the work in these spaces is completed.	Yes ☐ No ☐
• Will both the Contractor and City personnel be working in or near the permit-required confined space(s)? • If yes, determine if the Project Manager/Coordinator or the Contractor will coordinate entry operations to assure that everyone is aware of any work that is taking place that could affect personnel in the confined space. • If yes, provide a copy of the City's Confined Space Program to the Contractor and require that he or she conform to the requirements of that program. • If yes, at the end of entry operations, obtain a copy of all canceled permits, and send a copy of this information to the Water Resources Safety Coordinator.	Yes ☐ No ☐

Hazard Communication: Provide the following to the Contractor: • Information on precautions and safety procedures that must be followed in the work area. • Access to MSDS for hazardous chemicals located in the work area. • Information regarding the labeling system used in the work area. • Emergency procedures to be followed in the event of accidental exposure or release of hazardous chemicals or materials. Obtain a list of, and MSDS for, all chemicals that the Contractor will be using. Provide a copy to Project Manager/Coordinator for review and approval. The Contractor understands that MSDS must be kept on-site for all chemicals used by the Contractor on City property, and that no other chemicals may be brought on-site without prior approval by the Project Manager/Coordinator.	Yes ☐ No ☐
Will Personal Protective Equipment be required on the project site? • If respiratory protection or hearing protection is required, obtain copies of the contractor's Respiratory Protection and Hearing Conservation Programs	Yes ☐ No ☐
Will work by the Contractor involve electrical or mechanical systems? • If yes, inform the Contractor of the lockout/tagout procedures followed by City personnel. Make sure that all City employees in the work area are aware of the Contractors lockout/tagout procedures.	Yes ☐ No ☐
Will Hot Work Permits be required during the Contractors work? If yes, coordinate Hot Work permits with designated personnel.	Yes ☐ No ☐
The Contractor understands that any hazardous waste generated during the work must be disposed of in a manner consistent with all applicable state and federal regulations, and that prior approval is required for the disposal method and disposal site?	Yes ☐ No ☐
The Contractor representative understands that it is his/her responsibility to relay the above information to other contract employees and his or her subcontractors.	Yes ☐ No ☐
The Contractor has been given the opportunity to ask questions and have those questions answered to his/her satisfaction.	Yes ☐ No ☐